CONTRIBUTIONS TO A KNOWLEDGE OF THE BIOLOGY OF THE RICHMOND RIVER.

By G. I. Playfair, Research Scholar of the University of Sydney in Hydrobiology and Plankton.

(Plates ii.-viii.)

The material which has given occasion for the following notes was obtained from the Richmond River and tributary creeks, principally in the neighbourhood of Lismore, during the spring and summer of 1912-13. Lismore lies on the North arm of the river at the head of the navigable portion, and my richest gatherings were made in the short stretch of river, almost undisturbed by traffic, between the bridge and the boatshed. Here, on either side, were to be found huge beds of weed, chiefly *Myriophyllum* and *Elodea*, many yards in extent, and reaching right up to the surface of the water. The river remained undisturbed by heavy rains from the end of September, 1912, to the beginning of February, 1913, and the current being very slow indeed, the surface of these weed-beds became increasingly rich in both plant and animal life. Upon two occasions gatherings were made with silk plankton-nets, but these proved disappointing, nothing being obtained but *Coscinodiscus lacustris* and a few other diatoms, and as the weed-beds themselves constituted a very efficient filter, it was determined to rely altogether upon them.

On the main river, a single sample was obtained at Casino, near the bridge, three mucous strata from the river-brink at Coraki, and a stripping from a small bunch of weeds in a tributary creek at Kyogle.

Samples.—Nos.1-3, 5, 6, 8, 11-13, 15-18, 20-22* are from squeezings of weeds, chiefly out of the river at Lismore, two or three out of tributary creeks. Nos. 7 and 9 are silk-net gatherings, also from the river at Lismore. No.14 out of weeds and *Hydrodictyon reticulatum* from the river at Casino. Nos. 24 and 33, mucilaginous gouts from an open drain in Keen Street, river-water. Nos.25 and 26, mucous strata on the footpath near the Commercial Hotel, caused by a leaky fire-hydrant, river-water. Nos. 27-29, 39 and 40, mucous strata from the river-brink at Coraki. Nos. 30 and 34, scrapings from the basin of the horse-trough near the Gov. Savings Bank, river-water. No.41 from weeds out of a tributary creek at Kyogle, running water. This last, a very small gathering, is remarkable for the number of forms contained in it, especially Desmids, which do not take kindly to running water.

Character of the Flora and Fauna.—The outstanding feature of the Richmond River flora is undoubtedly its richness in diatoms, of which it forms almost a synopsis of the district. Of 147 forms noted in the latter, from Kyogle to Bexhill, 132 occur in the river-system, belonging to 75 generally recognised species. It is not surprising, therefore, to find also a considerable number of the *Myxophyceæ*, as these two groups generally flourish together. Of seven species of the latter, the principal source was indeed on land, in situations (horse-trough, footwasher, fire-hydrant, or open drain) supplied by river-water, but of these seven, four were also noted in the river itself.

The following tables show the relative proportions of the constituents of the Flora and Fauna of the Richmond River, compared with those of the Nepean River (Sydney water), Yan Yean Reservoir, Melbourne, the Central African Lakes, and the Lochs of the West of Scotland, as far as they have been noted.†

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* For convenience, the local numbers 1-41 have been used in these notes; they correspond to Nos.176-216, inclusive, in the National Herbarium, Sydney, where the originals are deposited.

† Cf. These Proceedings, Vol. xxxvii., 1912; Journ. Linn. Soc. Bot., Vol. xxxix., 1909; *ibid.*, Vol. xxxviii., 1907; Trans. Roy. Irish Acad., Vol. xxxiii., 1906, respectively.

FLORA.

ALGÆ.	Richm.	Nepean.	Yan Yean.	Afr. L.	Scottish L.
Chlorophyceæ.........	57	60	25	43	31
Desmidiaceæ	57	112	61	19	102
Bacillarieæ............	134	48	19	58	38
Myxophyceæ	38	19	4	36	16
Phytelieæ............	...	16	...	2	...
ALGAL FUNGI.					
Chytridiaceæ	6		not noted.		
Schizomycetes	13				
	305	255	109	158	187

FAUNA.

Dinobryon	nil	3	3	nil	6
Peridinieæ	nil	13	1	5	12
Vermes	5	3			
Tardigrada............	1	nil			
Entomostraca.........	6	3	not noted.		
Rotatoria	14	14			
Infusoria	34	35			
Rhizopoda	33	13			
	93	84			

Plankton.—After my experience of the Nepean water, in which the *Phytelieæ* and *Peridinieæ* were so remarkably well represented, it was disappointing to find them both absent from the Richmond. This was the case with *Rhizosolenia* and *Dinobryon* also.

Desmidiaceæ.—The Desmid flora seems to me to be extraordinarily rich, in face of the decided preponderance of the *Diatomaceæ*, the number of forms being almost equal to that of the Yan Yean plankton with only 19 diatoms. Of the 57 forms noted, exactly half belong to the genus *Cosmarium* (29), and a little more than one-quarter to *Closterium* (15); *Gonatozygon* 1, *Docidium (Pleur.)* 2, *Penium* 2, *Micrasterias* 2, *Euastrum* 1, *Staurastrum* 5, make up the remainder. One is prepared for the absence of *Xanthidium*, the forms of that genus being principally swamp-dwellers, but considering that almost all the gatherings were shaken out of weeds, the extremely poor representation of *Staurastrum* is surprising. In the main gatherings only three species were noted, *St. retusum* Turn., *St. striolatum* Näg., and another; the other two, in an isolated sample from Kyogle, were *St. dilatatum* var. *obtusilobum* De Not., and another (unidentified). Of the long-rayed forms, not a trace was to be found, nor were there present any of the variations of *St. orbiculare*, so common in the Nepean water. *Euastrum* was also conspicuously absent, two specimens only (of *Eu. binale* f.) having been noted in a net-gathering.

Chlorophyceæ.—These total up well, but in the fresh gatherings they were very poorly represented indeed, both in species and in numbers. *Spirogyra maxima* was plentiful at Lismore, and *Hydrodictyon reticulatum* was found in great abundance, covering the surface of the river, at Casino, but the commonest forms of *Protococcoideæ* had to be diligently sought for. All the usual members of the *Chlorophyceæ* were represented, however, the same genera almost exactly as in the Sydney Water with the exception of *Nephrocytium*, *Oocystis*, *Eremosphæra*, *Botryococcus* and *Ineffigiata*. As these are found here in swamps and lagoons, their presence in the Nepean water would seem to indicate some infiltration from a similar source. All five, but especially the last two, get the credit of being plankton-algæ, but all my observations of their occurrence go to show that their home is in swamps and lagoons.

With regard to the Fauna, the *Peridinieæ* and *Dinobryon* have already been mentioned; there was a good array of *Rotatoria*; the *Rhizopoda* were plentiful and in fair variety. Of the *Infusoria*, the flagellates *Euglena*, *Phacus*, *Lepocinclis* and *Trachelomonas* were almost entirely wanting, *Mallomonas* and *Synura* altogether so. But then the swamps and lagoons of the district seem to be quite separate from the river-system.

The number of organisms noted in the Richmond River and creeks amounted to Flora 305, Fauna 93, total 398. Of these, 81 and 14 respectively are here described as, to a greater or less extent, new forms. They are allocated thus :—*Chlorophyceæ* 18, *Desmidiaceæ* 10, *Bacillarieæ* 32, *Myxophyceæ* 13, *Chytridiaceæ* 4, *Schizomycetes* 4, *Infusoria* 4, *Rhizopoda* 10.

CHLOROPHYCEÆ.

Genus Geminella Turpin.

Geminella interrupta var. cylindrica, n.var. (Pl. iii., f.31).

Cellulæ cylindraceæ adpressæ, ad genicula constrictæ; chloroplastidibus crassis parietalibus, totam cellulam complentibus, utroque polo macula minuta nigra.

Diam. cell. 6, alt. 6-10 μ.

Lismore (20*b*).

Genus Spirogyra Link.

Spirogyra maxima (Hassal) Wittr.

Lat. cell. veg. 108-130; cell. alt. 120-340; membr. crass. 1-4 μ.

Zygospora a fronte visa exacte circ., diam. 110-112; subcirc., long. 112-136, lat. 100-116; crass. 84-92 μ.

Lismore (12, 16, 20, 21).

Syn. *Sp. orbicularis* (Hass.) Kütz., in Petit, *Spirog.* de Paris, p.31, Pl. xii., f.1, 2. I have never found this species before, but it is the characteristic *Spirogyra* of the River at Lismore, being found in quantity almost anywhere. The breadth of the vegetative cells is generally 120 μ. The chloroplasts are six in number, making $\frac{1}{2}$ to 1 turn each. The dimensions here given, unite the forma *tenuior* Magn. et Wille, in Wille, Sydamer. Algfl., p.34, with the type as recorded by Petit, l.c., p.31. It seems also very probable that the *Sp. setiformis* f. *minor*, zygotis lenticularibus Magn. et Wille, is a form of *Sp. maxima*, as Möbius (Austral. Süssw., ii., p.334) has recorded the latter from the Darling Downs, Queensland, at still lower dimensions. Petit gives the zygospores of *Sp. setiformis* as elliptic, not lenticular, and the cell-membrane of *Sp. maxima*, as observed by me, was just as often stratified as not. A few filaments (diam. 120 μ) were noted with extremely long cells, yet in perfect condition. The cells varied in length from 1026 to 1035 μ, and contained six chloroplasts making three complete turns each (20).

SPIROGYRA LISMORENSIS mihi. (Pl. iii., f.1).

Diam. cell. veg. 14; cell. alt. 80-300 μ.

Lismore (12).

Cells very long for the diameter, containing a single broad chloroplast, not wound spirally, but twisted round its long axis; pyrenoids in a single row down the centre; chloroplast making 5 to 15 turns, edge somewhat laciniate; ends of the cells reflexed 2 μ. I have given this curious and interesting form a name, but I do not consider it a distinct species. It is highly probable that each chloroplast splits longitudinally into two which become spirally disposed. Some were already divided at the ends, and there were other *Spirogyra* filaments with two tæniæ in the same gathering. The latter (diam. 18 μ, cell. alt. ca. 160 μ) might be *Sp. inflata* (Vauch.) Rab., but with both forms infertile, there could be no certainty about either. Cf. *Spir. Goetzei* Schm., Ergeb. d. Nyassasee, p.251, Pl. iv., f.8.

DESMIDIACEÆ.

Genus GONATOZYGON DeBary.

GONATOZYGON KINAHANI (Arch.) Rab., f. (Pl. iii., f.32).

Forma apicibus extremis quam levissime angustatis.

Long. 288-470, lat. 13-14, ap. 12-13 μ.

Lismore (18).

The apices, which are generally somewhat inflated, are in this form just a little narrower, no membranous tag at the angles.

Genus PENIUM Bréb.

PENIUM AUSTRALE, forma CRASSIOR G. S. West.

Zygospora matura globosa, levita angulata, spinis brevibus e tumoribus orientibus ad angulos munita, spinis maturis bifidis. Membrana crassa.

Long. 66-90, lat. 48-54. Zygo. diam. s. sp. 65; spin. long. ad 14 μ; membr. 4 μ.

Lismore (12), Casino (14).

Cf. G. S. West, Third Tanganyika Exp., p.108, Pl.6, f.4. The diameter of the type is 38 μ. The endochrome is arranged in two main radiating chloroplasts each containing a pyrenoid, but besides these there are 10-15 very narrow radiating laminæ without pyrenoids. A specimen was noted with the central pyrenoid divided into three. (Pl. iii., f.2).

Penium globosum var. Wollei (W. & G. S. West) mihi, f. *maxima*.

Long. 70, lat. 54 μ.

Lismore (12). Cum priori. (Pl. iii., f.3).

Cf. *Cos. globosum* var. *Wollei* f. *major* G. S. West, l.c., p.118, Pl.7, f.10, with which it is practically identical, but half as large again. The naming of this form affords an example of the difficulties arising from the present system of nomenclature, and the absolute impossibility of making the latter the expression of observed biological facts. When any *Penium* of the *Dysphinctium* type undergoes rapidly repeated mitosis, the nascent semicells have (in the short interval between one cell-division and another) no time to attain their full proportions; the resulting *Penium*-cells tend, therefore, more and more to become globose in shape, the diameter remaining practically unchanged. *Cos. globosum* Buln., is such a form, probably (diam. 22-25 μ, Monog., iii., p.27) the shortened form of *Pen. polymorphum* (diam. 21-28 μ, Monog., i., p.91) or some other *Penium*. *Cos. globosum* var. *Wollei* f. *major* G. S. West, (diam. 37-39 μ) l.c., is certainly a diminished *Pen. australe* (diam. 36-38 μ) type, just as my f. *maxima* (*supra*) is of *P. australe* f. *crassior* G.S.W. I find it so in this gathering (12), and if the notes by G. S. West, l c., p.118, on *Cos. globosum* be compared with those, p.108, on *P. australe*, it will be seen that, in the case of Victoria Nyanza at least, the specimens of both were found in the same gatherings:—Bukoba (20 Apr., 1905; No.251 and No.618). *Cos. globosum* is not *really* a species at all, but merely a mixture of degenerate forms of various "species" of *Penium*, brought together under one name on account of a similarity of shape. But it would be unreasonable to make such a distinct form as *P. australe* a variation of *Cos. globosum* (which has priority) although they are biologically connected. There is nothing left, therefore, but to accept *Cos. globosum* as a species, well knowing it to be a mass of contradic tions. I have ventured, however, to move it to the genus *Penium*, as the arrangement of the chloroplasts is not at all that of *Cosmarium* (*sensu stricto*).

Genus CLOSTERIUM Nitzsch.

Four forms of *Closterium* rather common in the river at Lismore are *Cl. Ehrenbergii*, *Cl. Leibleinii*, *Cl. moniliferum* and *Cl incurvum*. I consider these are forms of the same species, the difference being a mere matter of development. The zygospores also of *Cl. Ehrenbergii* and *Cl. moniliferum* are identical, Monog., i., pp.143, 144, Pl.17, f.4. The last three were found together at Kyogle also.

CLOSTERIUM ACEROSUM (Schrank) Ehr.

Long. 460-655, lat. 42-50, ap. 6 μ.

Lismore (3, 16, 19), Casino (14).

Fairly plentiful; the membrane pale pink, smooth or very finely and faintly striate, 10-12 ridged chloroplasts, 11-20 pyrenoids in semicell. The edges of the chloroplasts are sometimes scalloped towards the apices of the cell.

Var. LANCEOLATUM (Kütz.) mihi. (*Cl. lanceolatum*).

Long. 300-310, lat. 48, ap. 6 μ.

Lismore (22).

Cl. lanceolatum is only a short form of *Cl. acerosum*.

Var. ANGOLENSE W. & G. S. West, f. (Pl iii., f.4).

Forma semicellulis infra apices ut in *Cl. turgido* incrassatis; polis levissime recurvatis; apicibus extremis ut in *Cl. aceroso* truncatis. Membranâ hyalinâ (apicibus extremis exceptis) vel dilute rufescente. Interdum ad suturam zona intercalata (lat. 6 μ).

Long. 840, lat. 40. ap. 6 μ.

Casino (14). Cum priori et sequenti.

Cf. W. & G. S. West., Monog., i., p.149, Pl.18, f.6. This form combines in itself the characteristics of four "species." It has the extreme tip of *Cl. acerosum*, the size and shape of *Cl. acerosum* var. *Angolense*, the recurved ends and slight curvature of *Cl. Pritchardianum*, and the subapical incrassate zone of *Cl. turgidum*.

Var. CASINOENSIS, n.var. (Pl. iii., f.5).

Forma semicellulis sciagraphiâ *Cl. aceroso* consimilis ad polos non recurvatis, infra apices seriebus singulis nodulorum incrassatorum circ. 10 ornatis. Membranâ dilute rufescente, dense scrobiculata, utrinque ad nodulos longitudinaliter striata; interdum membranâ glabrâ vel subtilissime striatâ.

Long. 560-640, lat. 44-50, ap. 6 μ.

Casino (14).

This is almost the exact shape and size of *Cl. turgidum* f. *glabra* Gutw., Nonn. Alg. Nov., p.5, T.v., f.10. The scrobiculæ are on the inner side of the membrane, which is striate just for a short distance above and below the incrassations. The striæ run alternately through and between the incrassations.

Other forms of *Closterium* noted were *Cl. acutum* and var. *linea*, *Cl. gracile*, *Cl. cornu*. The plankton-forms, *Cl. gracile* var. *elongatum* W. & G. S. West, and *Cl. acutum* var. *subpronum* (W. & G. S. West), which might have been expected, and are not uncommon round Sydney, were not observed. The current of the river, however, is very sluggish.

Genus COSMARIUM Corda.

COSMARIUM ANGULATUM f. MAJOR Grun.

Long. 70-82, lat. 44-48, ap. 20, isth. 15-16, crass. 30 μ.

Lismore (12), Casino (14). (Pl. iii., f.6).

Syn. *Cos. Bengalense* Turner, Alg. E. Ind., T.8, f.33, and T.9, f.33. A very rare desmid this, only twice noted before, viz., from Banka I. and Bengal. Cf. Grunow, Insel Banka, T.ii., f.24, (whose figure works out at $63 \times 40\ \mu$) and Turner, l.c., p.56, T.8, f.35, and T.9, f.25. Our specimens are not so retuse in the sides as in Grunow's figure. Membrane smooth but sometimes faintly and closely pustulate, and there were no signs whatever of the inflations indicated by Grunow. When the chloroplasts are in good condition, their surface is divided into minute digitate fibrillæ, as noted by Turner, l.c., and Wallich. They are most noticeable at the isthmus. My opinion of this desmid is that it is a *forma maxima* of *Cos. Meneghinii*.

Var. CONICUM, n.var. (Pl. iii., f.7*a*).

Forma brevior, lateribus planis nec retusis, superne etiam quam levissime convexis.

Long. *semicell.* 34, lat. 44, ap. 16, isth. 14 μ.

Lismore (12). Cum priori.

Var. SUBCUCUMIS (Schm.) mihi. (Pl. iii., f.8).

Long. 70, lat. 46, isth. 14 μ.

Lismore (12). Cum prioribus duabus.

Syn. *Cos. subcucumis* Schmidle, Schwarz. u. Rheineb., p.98, T.4, f.20-22; W. & G. S. West, Monog., ii., p.155, Pl.70, f.1-3. *Cos. subcucumis* is the result of a double division in *Cos. angulatum* f. *major*, as the figures plainly show. The specimens were all in the same drop. Var. *subcucumis* is reniform, suborbicular or approaching to conical according to growth. Dimensions of the mixed forms :—

1. *Cos. ang.*(a):—long. semi. 40, lat. 46, ap. 16, isth. 14 μ.
   Var. *subc.*(b):—long. semi 34, lat. 44 μ. (Pl. iii., f.9).
2. *Cos. ang.* v. *conic.*(a):—long. semi. 34, lat. 44, ap. 16, isth. 14 μ.
   Cos ang. v. *subcuc.*(b):—long. semi. 28, lat. 40 μ. (Pl. iii., f.7).

The size of var. *subcucumis* (2b, *supra*) agrees with the smallest dimensions (54 × 44) given by Schmidle. Pl.70, f.4, of the Monograph shows a semicell approximating in outline to *Cos. angulatum* var. *conicum.*

Cos. SUBCOSTATUM var. BECKII (Gutw.) W. & G. S. West.

Long. 34, lat. 28, ap. 12, isth. 8 μ.

Lismore (12). Plentiful. (Pl. iii., f.10).

The apex was 4-granulate, but the inner two granules were geminate. None of the Casino forms of this group were noted in the Lismore branch of the river.

Var. AUSTRALE, n.var. (Pl. iii., f.11).

Formæ *minori* proximum, granulis autem medianis nullis. Semicellulæ semicirculares, apicibus angustis 4-granulatis, lateribus e basi rectis, superne valde rotundatis, crenis bigranulatis 2, crenis simplicibus basalibus 3.

Long. 26, lat. 22, ap. 10, isth. 6 μ.

Casino (14).

Shows its intimate connection with *Cos. Blyttii* in the characteristic absence of the tumour.

Cos. Blyttii var. Richmondiæ, n.var. (Pl. iii., f. 12).

Forma var. *Novæ-Sylviæ* proxima, paullo autem major, apicibus angustioribus. Semicellulæ lateribus e basi divergentibus, angulis basalibus haud rectis. Apicibus 4-granulatis; lateribus crenis bigranulatis 2, crenis simplicibus basalibus 2; supra isthmum tumore nullo nec granulis.

Long. 24, lat. 20, ap. 7, bas. 16, isth. 6 μ.

Casino (14). Cum priori.

This form is intermediate between *Cos. Blyttii* and *Cos. subcostatum* f. *minor*. It follows the Australian form of the type in having no papilla or granules above the isthmus. There is an odd granule below the depression on either side of the apex.

Var. Casinoense, n.var. (Pl. iii., f.13).

In ambitu formæ typicæ similis, sed major. Semicellulæ lateribus crenis bigranulatis singulis, crenis simplicibus basalibus 2; supra isthmum tumore plus minus circulari, 8 + 1 granulis seriebus verticalibus 3 ordinatis, ornatæ. A vertice ellipticæ, polis late rotundatis, medio utrinque tumore 3-granulato instructæ.

Long. 24-26, lat. 20-22, ap. 10, isth. 6 μ.

Casino (14). Cum prioribus duobus.

Combines the form and marginal granulation of *Cos. Blyttii* with the tumour of *Cos. subprotumidum*.

Cos. Seeleyanum var. elegans, n.var. (Pl. iii., f.14-16).

Semicellulæ tumoribus granulis 9 in seriebus verticalibus 3 ordinatis; lobulis subapicalibus a tumore radiantibus. A vertice ellipticæ, utroque latere, in medio, tumore 3-granulato (lat. 5 μ) ornatæ, utrinque ad tumorem excavatæ.

Long. 24-26, lat. 20-22, ap. 12-13, isth. 6, crass. 13-14 μ.

Casino (14). Cum prioribus tribus.

Since Wolle described it from New York, this rare desmid has only once before been reported, by Möbius from Victoria Park, Brisbane. The apex is 4-granulate, but the two inner granules show a tendency to become geminate. These four were all found together in one gathering (14), and are all intimately connected biologically. Several mixed forms were seen.

Cos. magnificum var. Italicum Rac.

Long. 118, lat. 96, ap. 30, isth. 78, crass. 60 μ.

Lismore (12).

In this form, there are no decided granules or scrobiculæ in the central portion of the semicells, granules only at the edge and for a short distance inside. It is an intermediate form between the type and *Cos. Askenasyi*, which is the smooth form of *Cos. magnificum.* The fact that this desmid, one of the largest of the genus *Cosmarium*, was reported from Italy by Raciborski, and from Sweden by Borge, after having been originally described from New Zealand by Nordstedt, is not only interesting, but it throws a strong sidelight on the question of the meaning of the word species in the *Desmidiaceæ.*

Var. fluviatile, n.var. (Pl. iii., f.17),

Semicellulæ truncato-conicæ ; lateribus deplanatis ; apicibus truncatis; angulis basalibus late-rotundatis; verrucis quadratis totam marginem complentibus, juxta suturam dente singulo utrinque munitæ. Supra isthmum tumore nullo nec scrobiculis, verrucis regulariter decussatim dispositis.

Long. 132, lat. 94, ap. ca. 30, bas. 74, isth. 36 μ.

Lismore (11). Cum formâ typicâ.

Cf. Nordstedt, Frw. Alg. N.Z., p.62, Pl.6, f.19. *Cos. magnificum*, in common with most of Nordstedt's New Zealand types, is found generally distributed in New South Wales. The short spine at the basal angle seems to indicate that the verrucæ may be interchangeable with spines. Cf. *Cos. subbalteum* Schm., Ost-Afrika ges. Desm., p.25, T.ii., f.29, which is also a form of *Cos. magnificum.*

Cosmarium dentiferum Corda. (Pl. iii., f.18).

Long. 106, lat. 114, isth. 30 μ.

Lismore (18). Cf. W. & G. S. West, Monog., iii., Pl.78, f.18.

Var sublatum (Nord.). (Pl. iii., f.22).

Long. 110, lat. 110, isth. 28, bas. 94 μ.

Lismore (18). Cf. Nordstedt, Frw. Alg. N.Z., Pl. v., f.3.

Var. PORRECTUM (Nord.). (Pl. iii., f.19, 20).

Long. max. 68-72, centr. 64-70, lat. 70-74, bas. 54-60, isth. 20, crass. 30 μ.

Lismore (12). Cf. Nord., Desm. C. Braz., T.3, f.28.

MIXED FORM. (Pl. iii., f.21).

a. Var. *porrectum* (Nord.).

Long. *semic.* 36, lat 74, isth. 18, bas. 56 μ.

b. Var. *quadrum* (Lund).

Long. *semic.* 36, lat. 64, bas. 56, crass. 36 μ.

Lismore (17).

The above are, undoubtedly, all forms of one species Those in samples 17, 18, were gathered from the same place on the same day; those in 12, from the same position two months earlier. They all have the same characteristic end-view, oblong almost cylindrical, with parallel sides and broadly rounded ends. The arrangement of the granules is the same also, viz., in vertical and decussating series. It should be noted that the forms of *Cos. porrectum*, in figs.20 and 21*a*, are really intermediate between *Cos. porrectum* Nord., type, and *Cos. sublatum* Nord. The forms of *Cos. dentiferum* may nearly always be recognised by the large, quadrate, smooth space at the isthmus, caused by the tendency in the semicells to be reniform, above and below which are generally five granules forming an angle. Besides those mentioned here, other desmids included in this species are :—*Cos. reniforme* Ralfs, and *β compressum* Nord., the latter widespread in this country, *Cos. orthopleurum* R.&B., *Cos. margaritatum* (Lund), *Cos. pardalis* Cohn, *Cos. lacunatum* G. S. West, and *Cos. pseudobroomei* Wolle.

PROTOCOCCOIDEÆ.

Genus CHLAMYDOMONAS Ehr.

CHLAMYDOMONAS INTERMEDIA Chodat.

Long. 17, lat. 10 μ.

Lismore (13).

Four in a mucous cœnobium, stirring but not yet motile, the contractile vesicle, however, could be seen working Chodat gives "long. 18-20 μ, cellules oblongues." *Ch. intermedia* is the prevailing form of the genus in this country. In small two-celled cœnobia, the cells are always disposed head to tail. If by nothing else, immature forms can generally be recognised by the presence of a minute clear spot at one extreme end.

CHLAMYDOMONAS GLOBULOSA Perty. (Pl. ii., f.1),

Diam. cell. 14-16, cell. matric. 26, aplanop. 12 μ.

Lismore (21).

Chl. globulosa (rare) and *Chl. Steinii* Gorosh.,(very rare) are the only other species that I have met with in New South Wales. *Chlamydomonas* could only be said to just occur in the river; it is noteworthy that neither *Gleocystis vesiculosa* nor *Sphærocystis Schröteri* were present. I consider them to be its vegetative stages.

The gathering (14) from Casino having been kept for some months, two minute *Chlamydomonas* forms developed in some quantity. They were non-motile when observed, without flagella or stigma, but in the larger (12 x 7) a contractile vesicle was working. They denote, I fancy, the presence of *Chl. intermedia.* (Pl. ii., f.14, 15).

Genus VOLVOX (L.) Ehr.

VOLVOX AUREUS Ehr. (Pl. ii., f.2-4).

Cœn. matric. diam. 300, membr. crass. 3; cell. diam. 8; parthenog.(8) diam. 45-50 μ.

Lismore (20). Rare.

The cells were globose, the connecting strands quite plain, generally single, but sometimes geminate.

VOLVOX BERNARDII mihi. (Pl. ii., f.5-11).

Forma *V. aureo* similis, nullis autem filis cellulis conjungentibus. Cœnobii membrana plerumque crassa.

Cœn. matric. diam. 290-300, membr. crass. 3-6; cellulis pyriformibus vel globosis (ambitu circa 28) diam. 4-8, inter se distantibus 20-30. Cœnob. filial. (8-12) diam. 60-96, cell. diam. 2-4, inter se distant. 1 diam., parthenogonidiis (8-12) diam. 12-40 μ.

Many young specimens were noted, evidently not long freed from the mother cœnobium; their specifications were :—

Cœnob. diam. 74-96, membr. crass. 2-5, cell. (in ambitu circ. 16-28) diam. 4-6, inter se distant. 2-20, parthenogonidiis (8-12) diam. 16-42 μ.

Lismore (12, 16, 17). Common.

This is the *Volvox* recorded by Bernard, Desm. et Protococc., p.165, as *V. aureus* Ehr. In all the specimens noted, I looked very carefully for the connecting filaments, but without result. Bernard also remarks, l.c., p.166 :—"Je dois dire que, malgré toutes mes recherches, malgré l'emploi des grossissements les plus puissants et de réactifs variés, je n'ai pu arriver à les mettre en évidence . . . . il n'y avait pas le moindre trait plus fortement coloré réunissant les cellules les unes aux autres, ni la moindre trace quelconque pouvant faire croire à la presence de communitions plasmiques." There are so few points in which one species of *Volvox* can differ from another that the absence of these connective filaments seems to me a decided specific character.

A specimen was noted, in material that had been some time in a bottle, with all the cells of one hemisphere developed into oogonia. Cf. Overton, Gatt. Volvox, Pl. iv., f.28.

Cœnob. diam 210, membr. crass. 6; cell. (in ambitu circ. 14) diam. 7-8, oogoniis diam. 15-18 μ. (Pl. ii., f.10, 11).

Genus Eudorina Ehr.

Eudorina elegans Ehr.

Chloroplasts granular, cells diam. 6, 10, 12, 16, 18, 22 μ.

Lismore (12, 18).

A family of 16 cœnobia noted, cœnobia 16-celled. Family diam. 90, cœnob. 25, cells 5-6 μ.

Var. Wallichii Turner.

Chloroplasts very pale green, translucent, with a single large pyrenoid. Cœnob. diam. 60, cell. 10 μ.

Lismore (12).

Cf. Turner, Alg. E. Ind., p.155, T.xxi., f.10; Chodat, Alg. Vertes, p.151, f.76a, b. A fine family of 16 cœnobia seen, each 32-celled. Family diam. 350, cœnob. 60, cell. 10 μ.

Var. RICHMONDIÆ, n.var. (Pl. ii., f.12).

Chloroplasts bright translucent green, 2-4 large pyrenoids, generally 4 at the angles of a tetraëdron.

Cœnob. (16 cell) diam. 130, cell. 16-18 μ.

Lismore (12).

As Wallich remarks (in Turner, l.c.) about the preceding form, the cells (from a certain point of view at any rate) are so arranged in alternating superimposed squares, that the whole sixteen can be seen at one time. *Pandorina morum* present also.

UVA, n.gen.

Character idem ac speciei.

UVA CASINOENSIS, sp.unica. (Pl. ii., f.13).

Cœnobium uviforme, ovatum, fronte latius, e cellulis muco agglutinatis non autem involutis, exstructum; cellulis circa 16 (?8, 16, 32) magnis, ovatis, declinatis; flagellis longis (? binis); chloroplastidibus clare viridibus, granulosis, pyrenoidibus nullis (visis); stigmatibus obscuris.

Cœnob. long. 28-40, lat. 22-.. ; cell. long. 10-14, lat. 6-10 μ.

Casino (14). Plentiful.

This interesting flagellate was obtained from the river at Casino, out of *Hydrodictyon reticulatum.* The cells in the smaller specimens are distinctly ovate, with the narrower ends pointing backwards; but, with growth, they tend to become more nearly elliptical. I was not able to see whether the flagella are double or single; they are very long, quite equal to the breadth of the cœnobium, and seem to arise, not as one would suppose, from the point, but from the broad end of the cell. The organism moves straight forward, broad end first, with the greatest rapidity, revolving at the same time round its long axis, very different from the leisurely progression of *Eudorina* and *Pandorina.*

For genus *Trochisia*, see under *Chytridiaceæ*, *infra.*

Genus HYDRODICTYON Roth.

HYDRODICTYON RETICULATUM (L.) Lag.

Cellulæ perfecte cylindraceæ, endochromâ in reticulo irregulari dispositâ, pyrenoidibus minutis dispersis.

Cell. long. 200-300, lat. 36-44 μ.

Var. MINIMUM, n.var. (Pl. iii., f.23).

Cellulæ minimæ cylindraceæ, endochromâ in laminâ tenui parietali dispositâ, pyrenoidibus singulis minutis.

Cell. long. 22, lat. 7 μ.

Casino(14).

The chloroplast, when in good condition, extends the whole length of the cell, but very often is reduced to a band in the centre, as in *Myxonema*. Eichler, Okolic Miedzyrzeca, 1892, T.ix, f. 6, records a size larger than this (cells 46 × 12), but with the reticulate chloroplasts of the type.

Var. NODOSUM, n.var. (Pl. iii., f.24).

Forma in extremis cellulis leviter inflata, endochromâ reticulatâ.

Cell. long. 100-300, lat. 20-54 μ.

Casino(14).

In many instances, I noted a tendency for the pyrenoids to run in long spirals across the cells.

Var. BERNARDII, n.var. (Pl. iii., f.25).

Forma cellulis maximis, in extremis inflatis, membranâ crassâ, endochromâ dilute luteolo-viridi in granulis minutis diffusâ, pyrenoidibus majoribus granulatis.

Cell. long. 1020; lat. centr. 103, extr. 140, membr. ad 10 μ.

Casino(14).

Cf. Bernard, Desm. et Protococc., Pl. xv., f. 536, 537. All the above forms were found together in the same gathering. Bernard, l.c., records them also from Java. They are, of course, all stages of growth, but are quite distinct enough to be worth naming. It seems to me also that this plant, which I meet now for the first time, raises questions which have a decided bearing on our ideas regarding the growth of the freshwater algæ generally. Here is a plant whose cells can develop from 22 × 7 to 1020 × 140 μ (Bernard gives 25 × 8 to 2000 × 220 μ), while at the same time the endochrome twice entirely changes its disposition. Judged by this standard, all the forms of *Myxonema* or *Ulothrix* resolve themselves easily into one species. If the *Hydrodictyon* cell and its chloroplasts grow and develop, why not *Closterium* or *Gyrosigma?*

A cell that is free, has far greater opportunities for growth than one which forms part of a filament.

Genus Pediastrum Meyen.

Pediastrum tetras var. integrum (Näg.). (Pl. iii., f.26).

Cœnob. long. 26, lat. 20; cell. viv. lat. 12, alt. 10 μ.
Lismore (13).

In company with minute forms of *P. tetras*. This specimen was, originally, evidently a cœnobium of *P. tetras* of the 7 + 1 type. The central cell and four of the peripheral cells have died, but the outer ones still retain the size and shape of the cells of *P. tetras*. The three living cells plainly belong to *P. integrum* Näg. It is evident, therefore, that the cells of a cœnobium are in a state of growth, and that the peripheral cells develop from one form to another.

Pediastrum Boryanum var. capitatum, n.var. (Pl. iii., f.27).

Cellulæ exteriores ad cornua extrema globulis singulis instructæ.

Cell. diam. 32; alt. centr. 20, c. corn. 36; diam. corn ap. 3, globul. 7-8 μ.
Lismore (15).

Genus Kirchneriella Schm.

Kirchneriella lunaris (Kirchn.) Möbius.

Cell. diam. 7, crass. 2 μ.

Var. approximata, n.var. (Pl. iii., f.28).

Cellulæ crassæ; apicibus acutis approximatis, lateribus interioribus parallelis.

Fam. (8 cœnob., 8 cell.) diam. 80; cœnob. 25, cell. long. 11, lat. 10, crass. 5 μ.
Lismore (11).

Var. aperta (Teiling). (Pl. iii., f.29).

Cellulæ crassæ; apicibus acuminatis non autem acutis, lateribus interioribus planis, divergentibus.

Cœnob. (cell. 8) diam. 40; cell. diam. 10, crass. 5 μ.

Lismore (11). Cum priori.

Syn. *Kirchn. aperta* Einar Teiling, Svenska Bot. Tidskr., 1912, p. 276. This form is somewhat like *Selenoderma Malmeana* Bohlin, Ersten Regnellschen Exp., i., p. 21, T.i., f. 31-35. I doubt very much whether there is any difference between the two genera. Cf. also *Sorastrum bidentatum* Reinsch, De Spec. generibusque, T. i., f. D iv. *K. lunaris* var. *contorta* (Schm.), Pl. iii., f 30, and var. *gracillima* (Bohlin) also noted.

BACILLARIEÆ.

Genus Amphora Ehr.

Amphora coffæiformis Ag. (Pl. iv., f.1).

Long. 27; lat. valv. 7; crass. frust. 12, ap. 6 μ.

Lismore (5,13).

Syn. *A. salina* W. Sm. Striæ very fine and faint, hardly discernible.

Amphora veneta var. grossestriata, n.var. (Pl. iv., f.2, 3).

Striæ crassæ 6-7 in 10 μ.

Long. 32-75; lat. valv. 11-16, ap. 3-4; crass. frust. 12-16, ap. 6-8 μ.

Lismore (12, 13, 17, 20, 21, 22); Kyogle (41).

For the type, Cleve, Syn., ii., p. 118, gives long. 20-60, lat. 11-18, striæ 20 in 10 μ. In the river, this form was in company with *Cocconema tumidum,* and it was noticeable that the striæ on both were equal in number and of similar character.

Genus Cocconema Ehr.

Cocconema tumidum Bréb. (Pl. iv., f.4).

Long. 70-90; lat. valv. 20-22, ap. 8-10 μ Striæ 6 in 10 μ.

Lismore (1, 2, 6, 8, 11, 12, 15, 18, 20). Casino (14). Kyogle (41, 45).

Very common in the river. The boat-shaped frustule, rostrate-truncate ends, and especially the diamond-shaped area round the central nodule, define this form.

COCCONEMA ASPERUM Ehr.

Long. 105-200: lat. valv. 24-44, ap. 10-14μ. Striæ 5 in 10 μ.
Lismore (2, 11). Kyogle (41, 45).

Syn. *Cocc. gastroides* Kutz.: Cf. Heribaud, Auvergne, Pl. iii., f. 10: Cleve, Syn. Rare in Lismore gatherings, common in those from Kyogle. Striæ easily resolved, punctate.

Genus NAVICULA Bory.

NAVICULA MUTICA Kütz. (Pl. iv., f.5, 6).

Valvæ-ellipticæ vel elliptico-lanceolatæ.

Long. 16-28: lat. valv. 8-11: crass. frust. 8 μ.

Kützing's figure, Bac., Pl. 3, f. 32, does not show a pseudo-stauros, which in our specimens is nearly always present. When absent, in all forms the central nodule is accentuated.

Var. RHOMBOIDEA, n.var. (Pl. iv., f.7).

Valvæ rhomboideo-lanceolatæ, in medio modice angulatæ, ad apices rapide attenuatæ, lateribus planis vel levissime retusis, apicibus acute rotundatis

Long. 30-36: lat. 11-12, apic. 3-4: crass. frust. 6-11 μ.

Three forms of this variation were noted:—(1) with strongly accentuated central nodule and no pseudostauros; (2) with a pseudostauros; (3) with pseudostauros and divided columella. In girdle-view the sides are often considerably convex.

Var. OVALIS, n.var. (Pl. iv., f.8).

Valvæ late ellipticæ, apicibus late-rotundatis.

Long. 22: lat. valv. 10 μ. Rarissime.

Var. SUBHEXAGONA, n.var. (Pl. iv., f.9).

Valvæ subhexagonæ polos versus cuneatæ: apicibus interdum minute rostratis: lateribus in medio planis, parallelis, apices versus rapide convergentibus.

Long. 18-20: lat. valv. 8-9: crass. frust. 8 μ.

Observed also with a divided columella.

Var. SUBCIRCULARIS, n var. (Pl. iv., f.10-12).

Valvæ latissime ellipticæ pæne circulares, apicibus levissime acuminatis.

Long. 12-17; lat. valv. 10-12; crass. frust. 6 μ.

Noted with and without a pseudostauros, also with a narrow obscure fusiform transverse fascia.

Var. GOEPPERTIANA (Bleisch). (Pl. iv., f.13).

Valvæ ellipticæ, acuminatæ, interdum minute rostratæ; lateribus regulariter arcuatis.

Long. 24-36; lat. valv. 9-11, ap. 3; crass. frust. 4 μ.

Lismore, all seven forms (1); all except var. *ovalis* and var. *subcircularis* (6); var. *subhexagona* (1, 6, 13); var. *Goppertiana* (1, 6, 13, 31); var. *subcircularis* (1, 3, 5); var. *ovalis* (1).

All the seven are undoubtedly variations of the same species; they occur together in sample No. 1 (shaken out of weeds from one spot), and have all the same appearance under the microscope. They are finely striate, but appear quite smooth and pellucid under ordinary magnifications. It is impossible, I think, to consider the series of forms without admitting that the diatom-valve changes with growth from one outline to another, one variation developing naturally into another. Cleve, Syn. i., p. 129, 130, gives several forms with undulate margins, but I have not noted any of these. The girdle-view in var. *subcircularis* is exactly that of *Staur. polymorpha* Lagerstedt, Spetzbergen, Pl. i., f. 12*b*, (= *Nav. mutica* forma *Cohnii* Hilse, sec. Cleve, l.c.).

Genus DIPLONEIS Ehr.

DIPLONEIS BOLDTIANA var. AUSTRALICA, n.var. (Pl. iv., f.14-15).

Valvæ ellipticæ, lateribus haud deplanatis. Striæ 10 in 10 μ.

Long. 35-36; lat. valv. 16-17; crass. frust. 10 μ.

Lismore (2, 11, 13).

Var. OVALIS, n.var. (Pl. iv., f.16).

Valvæ late-ellipticæ, ovales. Striæ 10 in 10 μ.

Long. 20-30; lat. valv. 14; crass. frust. 10 μ.

Lismore (2, 11, 13).

Var. ACUMINATA, n.var. (Pl. iv., f.17).

Valvæ ellipticæ, apicibus acuminatis, lateribus arcuatis.

Long. 15-26; lat. valv. 11-15, crass. frust. 10 μ. Striæ 10 in 10 μ.

Lismore(1, 6, 11). Kyogle(41).

The central nodule in all these forms is quadrate, diam. 2 or 4 μ.

The longitudinal furrow, 2-4 μ broad, seems (from broken specimens) to be a *lacuna* in the membrane.

Genus VANHEURCKIA Bréb.

VANHEURCKIA RHOMBOIDES var. NEGLECTA (Thw.) f. MINOR, n.f.

Forma dimidio brevior; valvæ lineares-ellipticæ, apicibus rotundatis; areâ centrali indivisâ.

Long. 27-40; lat. valv. 7-8 μ.

Lismore (2, 3, 6, 20). Kyogle (45).

The larger form (*Schizonema neglecta* Thwaites; *Nav. gracilis* var. *neglecta* (Thw.), W. & G. S. West; *Nav. gracilis* var. *schizonemoides* V.H.) measures 50-90 × 8 μ.

VANHEURCKIA CUSPIDATA var. DANAICA (Grun.).

Long. 73-80; lat. valv. 18 μ. Columella broad, undivided.

Lismore(3).

Navicula cuspidata and its forms should be arranged under *Vanheurckia*; there is no real difference between forms with divided and those with undivided central area.

Var. AMBIGUA (Ehr.).

Long. 70-75; lat. valv. 22, ap. 6 μ. Apicibus sæpe levissime capitatis.

Lismore(5). Casino(14). Kyogle(41).

Syn. *Nav. ambigua* Ehr. in Donkin, Br. Diat., Pl.6, f.5. *Nav. cuspidata* var. *ambigua* (Ehr.) Cleve. Specimens were noted with a single broad columella (with incipient median line, however, above and below the central nodule) and also with a double one. The median line (? true raphe or merely a furrow) in these *Vanheurckia* forms develops generally from the centre outwards. Beginning as a minute foramen on either side of the central nodule (and defining it), it gradually extends outwards to the terminal nodules, thus forming a double columella. Cf. *Vanh.* (*Frustulia*) *leptocephala* Oestrup, Oest-Grönland, T. i., f.1.

Var. KYOGLENSIS, n.var.

Forma maxima; valvæ lanceolatæ, apicibus obtusis minime protractis, quam levissime rostratis; areâ centrali (columellâ) longitudinaliter divisâ; membranâ grosse longitudinaliter striatâ, striis 7-8 in 10 μ.

Long. 180-200; lat. valv. 44-50, ap. 8-10 μ.

Kyogle(41).

Except for the longitudinal striæ, this form is identical with *Vanheurckia africana* G. S. West, Journ. Bot., 1909, p.246, Pl. 498, fig.18.

Geuus AMPHIPRORA Ehr

AMPHIPRORA ALATA var. HOLDERERII (Gutw.) mihi. (Pl.iv., f.18).

Long. 52 μ. Alæ valde sinuatæ.

Lismore(1, 2).

This form is only known besides from the Desert of Gobi, Central Asia. Gutwinski (Alg. in Asia coll., p.212, Pl. ix., f.7) makes it a variation of *A. paludosa*, but from the figures in Van Heurck (Diat., Pl.5) it seems much nearer *A. alata.* It is almost certain, however, that all these forms of *Amphiprora* are variations of one species.

Genus GOMPHONEMA Ag.

GOMPHONEMA AUGUR var. ROTUNDATUM (Ehr.) mihi.

Valvæ clavatæ, superne late-rotundatæ, apiculo minuto interdum instructæ; lateribus superne arcuatis, inferne rapide convergentibus, plus minus planis; apicibus inferioribus acute-rotundatis. Striæ 2-3 utrinque ad centralem nodulum plerumque alteris validiores.

Long. 30-54; lat. valv. 12-16, ap. 2-3 μ; striæ 7 in 10 μ.

Lismore (cum sequenti). (Pl. iv., f.19, 20).

Var. ANGULATUM. (Pl. iv., f.21, 22).

Valvæ juxta nodulum centralem latissimæ, hic modice angulatæ et prope etiam apicem superiorem, apiculo minuto interdum instructæ; lateribus inferne rapide convergentibus pæne planis, superne arcuatis convergentibus inter angulos deplanatis. Striæ 2-3 utrinque ad centralem nodulum plerumque alteris validiores.

Long. 40-57; lat. valv. 13-14, ap. 4 μ Striæ 7 in 10 μ.

Lismore(1, 6, 13, 15, 17, 18, 20, 21, 22), both forms together.

Gomphonema constrictum var. australe, n.var, (Pl.iv.,f.23).

Valvæ parte superiore valde inflata, apiculo lato munitæ; striis binis alteris validioribus utrinque ad centralem nodulum præditæ.

Long 50; lat. valv. cap. 16-18, constr. 10, centr. 13, bas. 5 μ.

Lismore(1, 2, 6, 8), cum forma typica.

Dimensions of the type are, here:—long. 40, lat. valv. cap. 12, constr. 10, centr. 13, bas. 5 μ.

Gomphonema triangulare, n.sp. (Pl. iv., f.24).

Valvæ minutæ, triangulares, prope apices latissimæ; lateribus ad basin angustatam rapide convergentibus; apicibus depressis subrostratis.

Long. 24; lat. valv. 10, ap. 3 μ.

Lismore(1). Rarissime.

Genus Achnanthes, Bory.

Achnanthes lanceolata (Bréb.) Grun.

Valvæ elliptico-lanceolatæ, apicibus late-rotundatis.

Long. 12-20; lat. valv. 7-8 μ. Striæ 9 in 10 μ.

Valvæ apicibus productis subrostratis, late-rotundatis.

Long. 20-25; lat. valv. 8-9, ap. 3-4 μ. Striæ 9 in 10 μ, utrinque 20-24.

Lismore(1, 6, 8, 17, 18, 20, 21, 22), both forms intermingled.

Cleve, Syn., ii., p. 192, gives striæ 13-16 in 10 μ.

Achnanthes calcar var. australis, n.var. (Pl. iv., f.25-26).

Valvæ elliptico-lanceolatæ, formâ typicâ præ latitudine longiores; apicibus acuminatis interdum quam levissime rostratis. Valva inferior lineâ mediâ solâ instructa.

Long. 16-22; lat. valv. 7-8, ap. 2 μ.

Lismore(6, 12, 13, 15, 17, 20).

Var. pulcherrima, n.var. (Pl. iv., f.27).

Valvæ lanceolatæ vel lineari-lanceolatæ, longiores; apicibus acute-rotundatis, interdum quam levissime rostratis.

Long. 24-40; lat. valv. 8-10, ap. $2\frac{1}{2}$ μ.

Lismore(17, 20, 21). In profusion(17).

Cf. Cleve, Diat. Finland, p.51, Pl. iii., f.8, 9. A very rare species, known (living) only from Finland, and fossil in Sweden from freshwater deposits of the Ancylus epoch. Striæ 24-25 in 10 μ according to Cleve, Syn., ii., p.174. Var. *pulcherrima* sometimes approaches in shape to *Ach. Hungarica* Grun.

Genus Cocconeis (Ehr.) Cleve.

Cocconeis placentula Ehr.

"Intus et extus lævis," Kütz., Bac., p.73.

Long. 22-36; lat. valv. 14-22, crass. 3 μ.

Lismore. Cum sequenti.

Var. euglypta (Ehr.) Cleve. (Pl. iv., f.28).

Forma utrinque ad lineam mediam striis longitudinalibus crassis rectis 5-6 ornata. Dimensiones et cetera ut in formâ typicâ.

Lismore(1, 6, 13, 17, 18, 20, 21, 22); both forms intermingled.

Var. lineata (Ehr.) Cleve.

Forma major, striis longitudinalibus 5-6 *undulatis* ornata.

Long. 40-46; lat. valv. 26-30; lat. annul. 3 μ.

Lismore(1, 6, 15, 20, 21). Cum f. typica rarius.

The wavy longitudinal striæ are an optical illusion caused by the transverse striæ decussating at a very obtuse angle. Cleve, Syn., ii., p.169, gives long. 40-70, lat. 30-40 μ for this form.

Var. australica, n.var. (Pl. iv., f.29).

Var. lineatæ consimilis, striis autem nullis; areâ centrali (?nodulo) circulari distinctâ instructa, lineis medianis binis arcuatis.

Long. 44; lat. valv. 30 μ.

Lismore(1). Rarissime.

Genus Epithemia Bréb.

Epithemia gibberula var. perpusilla, n.var. (Pl. iv., f.30).

Var. productæ consimilis sed minor; costis 5-6 dorso crassis ad zonam versus sensim attenuatis.

Long. 15-16; lat. valv. 6; lat. frust. 13, ap. 4 μ.

Lismore(2b), with var. *producta* Grun.

From Van Heurck's figures, Diat., Pl. 9, figs. 359, 360, 361, there would not appear to be any specific difference between *E. musculus* Kütz., and *E. gibberula* var. *producta* Grun., nor are Kützing's figures of the types, Bac., Pl. 30, f. 3, 6, sufficiently different for distinct species. In these latter, the lower figures in each case are not of frustules seen in girdle-view, but represent the two outer and opposite valves of a hemisphere of frustules cohering after division. The same is true of Van Heurck's figures, Diat., Pl. 30, f.825 (*sinistra*). *E. gibberula* has priority, as Kützing refers it to Ehrenberg.

Epi. Sorex, *E. zebra*, *E. turgida* var. *granulata*, and *E. gibba* var. *ventricosa* were also abundant both at Lismore and Casino. The three last from Kyogle also.

Genus Eunotia Ehr.

Eunotia formica var. Richmondiæ, n.var. (Pl. iv., f.31, 32).

Valvæ levissime arcuatæ, medio apicibusque subito inflatæ lateribus plus minus parallelis; apicibus acuminatis cuneatis.

Long. 56-124; lat. valv. 8-9, inflation. 10-14 μ.

Lismore (3, 6, 12, 17, 18, 22).

Forming long ribbons, in company with *Eun. depressa* Ehr. The latter is the only other form of *Eunotia* in the river, long. 24-96, lat. 8, ap. 5 μ, very common; cf. Kütz., Bac., Pl.30, the two unnumbered examples between figs.1 and 2.

Genus Synedra Ehr.

Synedra Lismorensis, n.sp. (Pl. iv., f.33-38).

Valvæ in medio constrictæ, papillâ minutâ etiam nonnunquam ornatæ; superne interdum paullo inflatæ, ad apices attenuatæ, apicibus rostratis. Striis tenuissimis circ 12 in 10 μ, in medio mancis. Latere cingulato frustulum rectangulare, interdum apices versus modice attenuatum, parte non striatâ ad angulos incrassatâ.

Long. 22-88; lat. valv. 4-6, ap. 2-3; lat. frust. 4-6 μ.

Lismore (1, 12, 13, 17, 18, 21). In profusion.

Every length, in successive increments of 2 μ, between 22 μ and 88 μ, was actually observed and measured. The frustules were in long ribbons, the shorter ones (long. 22 μ and upward) being quite as broad as the longest (or even broader) were very unlike *Synedra* in appearance.

Genus Surirella Turpin.

Surirella ovalis var. pinnata (W. Sm.) Van. Heurck.

Long. 30-40; lat. valv. 10-12, ap. 3-4; lat. frust. 8-12 μ. Costæ 5-6 in 10 μ.

Lismore (3, 12, 22). (Pl. iv., f.39, 40).

Syn., *Suri. lapponica* Astrid Cleve, Recent Frw. Diat., p.25, Pl. i., f.26. *S. ovalis* type also noted (long. 44-48, lat. 26 μ, costæ 18-20 a side) in Nos.2, 3, 11.

Var. Lewisii mihi. (Pl. iv., f.41-43).

Valvæ facie inflatâ; membrana media distincte marginata; costæ breves, validæ, lateribus parallelis, ad marginem membranæ abrupte terminatæ.

Long. 50-64; lat. valv. 32 μ.

Lismore (5).

Cf. *Suri. ovalis* Lewis, Diat. U. S. seaboard, p.63, Pl. 1, f.3. Lewis calls it "a sparangial form." Var. *Lewisii* has the same relation to the type that *Cyclotella Meneghiniana* β (var. *convexa* mihi, *infra*) has to its type. The costæ are convex and terminate abruptly at the edge of the central smooth membrane. In this form they increase in number by new ones forming between the others, growing from the edge outwards. Usually in *Surirella* the new marginal costæ, verrucæ or denticulations form at the apices, the latter being the growing points of the frustule.

Surirella plana G. S. West, forma. (Pl. v., f.1).

Long. 100-134; lat. valv. max. 44-50; lat. frust. ap. 36-48, bas. 24-30 μ.

Verrucæ marginales circ. 20; latere cingulato ut in *Suri. robustâ*.

Lismore. Cum sequenti rarius.

Var. ALGENSIS, n.var. (Pl. v., f.2, 3).

Valvæ breviores, præ longitudine latiores, ellipticæ plus minus ovatæ; costis 10-12, terminalibus 3 vulgo (interdum omnibus) simplicibus. Latere cingulato valde cuneato, apicibus latissimis ad basin rapide attenuatis; marginibus alarum medio retusis.

Long. 56-106; lat. valv. 34-56; lat. frust. ap. 36, bas. 20 μ.

Lismore (5, 7, 8). Cum priori.

Cf. G. S. West, Third Tanganyika Exp., p.165, Pl. 8, f.5; also *Suri. margaritacea* O. Müller, Bac. a.d. Nyassaland, p.37, Pl. 2, f.12, the latter probably a smaller size of var. *algensis* with the costæ broken up into rows of minute granules. I consider *Suri. plana* a variation of *Suri. robusta*, with one end (or both) very broadly rounded and a tendency to be ovate; in girdle-view they are identical. The girdle-view in var. *algensis* is characteristic, being strongly cuneate. The costæ are distinct to the centre, or merely marginal according, of course, to the silicification of the membrane. Some forms were noted with simple costæ only, proceeding from marginal denticulations as in *Suri. elegans* and *S. ovalis*. These costæ do not remain simple, however, but become double with growth of the frustule. *S. robusta* var. *splendida* in the same water (long. 136-140, lat. 48-50 μ); Lismore (6, 7, 8, 18), and Casino (14).

Genus NITZSCHIA Hassal.

NITZSCHIA PARADOXA (Gmel.) Grun.

Long. 80-100; lat. valv. 6, ap. 2 μ. (*Bacillaria paradoxa* Gmelin).

Var. MAJOR Van Heurck. (Pl. v., fig.4).

Long. 100-120; lat. valv. 8; lat. frust. 8, ap. 6 μ. Puncta 5 in 10 μ.

Var. PERPUSILLA, n.var. (Pl. v., f.5).

Forma minima; valvæ lineari-ellipticæ, apicibus acute-rotundatis nec rostratis.

Long. 22-40; lat. valv. 5; lat. frust. 6 μ.

Lismore (1, 2, 6, 8, 15, 17, 20, 21), type and var. *perpusilla*; var. *major* (7, 8).

Nitzschia vermicularis var. sialis, n.var. (Pl. v., f.6).

Forma a latere cingulato visa, apicibus attenuatis. Puncta carinæ 5 in 10 μ.

Long. 180-186; lat. valv. 8, ap. 3; lat. frust. 14, ap. 8-10 μ

Lismore (3, 12); in *Lyngbya* stratum (26).

Var. minuta, n.var. (Pl. v., f.7).

Forma minima, latere cingulato apicibus attenuatis, punctis carinæ sæpissime carentibus.

Long. 44-48; lat. valv. 4, ap. $2\frac{1}{2}$ μ.

Lismore, in *Lyngbya* stratum (26) cum priori.

The carinal dots in these forms increase gradually in number. They first elongate longitudinally and then divide into two granules, Granular and elongated puncta were noted intermingled in the same specimen, and with them also were some which were quite evidently half divided. It is one indication of a very slow process of growth and development which is taking place in the frustule.

Genus Tryblionella W. Smith.

Tryblionella Hantzschiana var. minor, n.var. (Pl. v., f.8).

Formæ typicæ (fig. *a* in Grun., Oesterr. Diat., T. xii) consimilis sed minor.

Long. 40; lat. valv. 14 μ.

Var. Victoriæ (Grun.) mihi. (Pl. v., f.9-11).

Long. 30-60 ; lat. valv. 15-22 ; lat. frust. 13-20, cingul. 5-8 μ. Striæ 24-36, 5-6 in 10 μ, equal in number to the marginal dots when present. Syn. *Trybl. Victoriæ* Grun., Oesterr. Diat., p.553, T.12, f.34. Both figures are tilted sideways, 34*b* very much so.

Var. calida (Grun.) V. Heurck. (Pl. v., f.12).

Long. 70-72; lat. valv. 10-12, ap. 2-3; lat. frust. 11, cingul. 3-4 μ.

Var. ovata (Lagerstedt) mihi. (Pl. v., f.13).

Long. 26-36; lat. valv. 14-18. Striæ circ. 20, 6 in 10 μ. Syn. *T. ovata* Lagerst., Spetzbergens, p.48, T.2, f.23. Lagerstedt's figure also is tilted sideways.

Var. AUSTRALICA, n.var. (Pl. v., f.14).

Valvæ elliptico-lanceolatæ, apices versus paullulo cuneatæ, apicibus modice subrostratis; lateribus in mediis valvis paullulo deplanatis; striis crassis haud punctatis, apices versus sæpe carentibus.

Long. 76; lat. 28 μ.

This variation combines in itself the characteristics of several forms. There is a general resemblance, especially in the subrostrate apex, to *Trybl.* (*Nav.*) *punctata*; in size, however, it agrees with *Trybl. Hantzschiana*, while in shape it leans somewhat to *T. ovata*.

TRYBLIONELLA CRUCIATA, n.sp. (Pl. v., f.15).

Valvæ late-lineares, in medio inflatæ, apicibus late-rotundatis. Striis transversis, 8 in 10 μ, evidenter punctatis.

Long. 48; lat. valv. centr. 16, ap. 11 μ.

Only one frustule noted, and the only one, too, among numbers of the others, in which the striæ were distinctly punctate. If *Trybl. punctata* had been present, I would have made it a form of that species.

Lismore, all six forms (1); var. *Victoriæ* (1, 3, 6, 12); var. *ovata* (1, 11, 18); var. *calida* (3, 20).

It is noticeable that these six forms of Tryblionella were all found in the same sample(1) out of a few heads of *Myriophyllum* gathered in one place. I cannot but consider them, therefore, all forms of one species. On account of its punctate striæ, however, *Tr. cruciata* has been kept separate. Following W. Smith, and Grunow (originally), I have classed these forms together under the old genus *Tryblionella*. Why should *Hantzschia* and *Stenopterobia* (whose forms much more resemble *Nitzschiæ*) be separated from *Nitzschia* and these forms remain? The structure of the frustule is on the lines of *Surirella*; the pseudoraphe, the costæ radiating more and more towards the apices where they are often absent or more delicate, the submarginal keel *on both sides* of the connecting zone (as also in *Stenopterobia*), the carinal dots originating near the apices and getting more complex as they approach the centre, all these remind one of *Surirella*. Also in *Suri. margaritacea* Müller, Nyassaland, i., Pl.2, f.12, we have a form of that genus with punctate costæ (probably temporarily only, however). The frustules of these *Tryblionellæ* are very narrow and compressed in girdle-view, and slightly twisted round their long axis. I am inclined to believe them degraded forms of *Cymatopleura solea*, which is found in the upper reaches of the river at Kyogle. In this connection, cf. Müller, Bac. aus Nyassaland, i , p.23, f.4.

Genus Melosira Ag.

Melosira varians var. moniliformis (O.F.M.). (Pl.v., f.16, 17).

Diam. 16-26; alt. cell. 16-26 (rare usque ad 60 μ).

Lismore (3, 5, 22). Cum formâ typicâ.

Cf. Kützing, Bac., p.53, T 3., f.ii., 1-3, whose figures work out at diam. 12-20 μ. *M. varians* (diam. 14-30 μ) is common in the river, being found in almost every gathering. (*M. granulata*, very rare, only once noted). In var. *moniliformis*, the cells become first semi-detached and later entirely free, in which condition they are liable to be mistaken for *Cyclotella* frustules.

Genus Cyclotella Kütz.

Cyclotella Meneghiniana Kütz., forma. (Pl. v., f.18).

Diam. 12-28; crass. 11-14 μ. Striæ in ambitu circ. 30.

In the type, the central area of the valve is not sharply outlined, the striæ are delicate, and the edge shows as a well-defined rim 1-1¼ μ in thickness. The girdle-view is rectangular, the face of the valve, with the exception of the inflated half of the central undulation (when present), being beneath the level of the edge. These specimens were not quite typical, since they were not quite rectangular in girdle-view, but somewhat inflated, the striæ showing over the edge.

Var. convexa mihi. (Pl. v., f.19, 20).

Valvæ areâ centrali distincte definitâ, glabrâ, areâ marginali rugosâ vel striatâ. A latere cingulato visæ, lateribus convexis in medio planis vel plus minus undulatis.

Diam. 8-36, diam. areæ centralis 8-15; crass. 8-20 μ. In ambitu striæ 24-30 vel, apud cell. validiores, rugæ 50-60.

This is var. β Kützing, Bac., T.30, f.68. It is quite unlike α, but the "*forma*" recorded above is quite certainly intermediate. Var. *convexa*, which is the characteristic *Cyclotella* of the river here, has a sharply defined exceedingly smooth area (generally in diameter about half that of the cell) in the centre of the face of the valve, and this part alone is undulate (but the undulation is often slight and sometimes absent). The marginal portion of the valve is convex, and in large forms of 30 μ and over, the striæ appear to be the edges of radiating corrugations. In a tilted cell, these show as crenulations at the edge. There is no definite rim.

Var. QUADRATA, n.var. (Pl. v., f.21, 22).

Valvæ sine striis, punctis autem intra margines notatæ. Cellulæ a latere cingulato pæne quadratæ, lateribus rectis. Tota facies valvæ levissime undulata.

Diam. 8-9; crass. 7 μ.

Var. *quadrata* is a form produced from var. *convexa* by long-continued mitosis. The striate marginal area has been gradually whittled away concentrically, and the frustule now consists merely of the central smooth area of the original cell, in which the undulation occurs. Hence in this form the undulation in girdle-view runs right across the valve instead of being confined to the central portion. The marginal striæ are represented by faint puncta within the rim itself. The diam. of the valve also is exactly the breadth of the smooth central area in the smaller sizes of var. *convexa*.

Var. BREVISTRIATA, n.var. (Pl. v., f.23).

Forma areâ centrali glabrâ præ diametro valvæ latissimâ, areâ marginali striatâ angustissimâ, striis brevissimis.

Diam. 12-14, areæ centr. 10 μ. Striæ in ambitu circ. 30.

This would seem to be an intermediate form in which the marginal striate area is not yet quite deleted, or else one in which it is gradually developing again by growth. The striæ end abruptly at the edge of the smooth central area, which is relatively very wide. With central area of 10 μ broad, the valve in var. *convexa* would have a diameter of 20-24 μ.

Var. FLUVIATILIS, n.var. (Pl. v., f.24).

Forma striis brevibus e denticulationibus marginalibus cuneatis orientibus.

Diam. 15-18, areæ centr. 8 μ. Striæ in ambitu circ. 30.

Lismore, all five forms (2, 20); var. *convexa* (2, 13, 17, 18, 20, 21, 22); var. *quadrata* (2, 5, 20, 21, 22); var. *fluviatilis* (2, 5, 20).

Genus HYDROSERA Wallich.

HYDROSERA TRIQUETRA Wallich. (Pl. v., f.26).

Long. (latere cingul.) 75-130; lat. 80-100; diam valv. 80 μ.

Lismore (16, 19, 21).

The valves are strengthened internally by septa across the salient (? and intermediate) angles, the lower, free, edges can be seen in girdle-view as flying arches. The two smooth vertical bands are the extension of the papillæ which appear at the margin in optical section. These are really (as in all other diatoms where they appear) loops of the inner incrassate membrane, which run right round the valve. The thin outer membrane remains flat, but often breaks away, showing the loop plainly as a marginal indentation. "Grunow and H. L. Smith unite the genus *Hydrosera* with *Pleurodesmium* and *Terpsinoë*, which have the same structure."—Van Heurck, Diat., p.453. The latter relies on the triangular valve as a generic character. I have not found any biradiate forms in the river. All three genera have this in common, that they consist of marine forms which are just as often found in the fresh water of rivers and far above all tidal influence.

Genus COSCINODISCUS Ehr.

COSCINODISCUS LACUSTRIS Grunow.

Diam. 34-78; striæ 8-9 in 10 μ; puncta circ. 10 in 10 μ.

The puncta may be noted arranged in many different ways, but most of these are merely transitory arrangements due to growth. In the perfect form, the puncta are in regular radiating lines, but frustules are common in which they are disposed quite irregularly or in fascicles with shorter rows filling the triangular marginal interspaces, or in arcs (decussating) from point to point of the circumference. In some specimens, they appear as arcs or in irregular radiating lines according to the focus. Sometimes, the puncta are very distinct and separate, at others, obscure or inclined to be confluent, at others, again, very delicate and hardly visible, sometimes, apparently absent.

There is a great general likeness between *Coscinodiscus lacustris* and *Cyclotella Meneghiniana* var. *convexa*, and I am not at all convinced that they are not stages of the same plant, and that this, the only freshwater *Coscinodiscus*, is not, as W. Smith considered it, a *Cyclotella*.

Var. PELLUCIDUS, n.var.

Valvæ membranâ glabrâ, striis punctisque nullis.

Diam. observ. 52-61 μ.

Var. STELLATUS, n.var. (Pl. v., f.27).

Valvæ membranâ glabrâ, areâ centrali nudâ, granulis marginalibus distinctis, striis spatio distantibus. Unicum frustulum tantum vidi.

Diam. observ. 50 μ, striæ long. 15 μ.

?Syn. *Cyclotella Kützingiana* Kirchner, in Forbes and Richardson, Biology of the Upper Illinois River, Pl.85, f.1. Each of the striæ proceeds from a marginal granule, probably intermediate striæ form between the others. No doubt an abnormal outgrowth of the foregoing.

Var. DENTICULATUS, n var. (Pl.v , f.28).

Valvæ granulis marginalibus in denticulos productis, inter se paullo magis distantibus.

Diam. 44-55 μ.

The marginal denticulations are 3 μ apart from centre to centre, in the type 2 μ. Is this identical with *Stephanodiscus Hantzschianus* Grun., in Van Heurck, Diat., p.520, Pl.23, f.662?.

Var. PAPILLATUS, n.var. (Pl. v., f.29).

Valvæ intra margines papillis humillimis 8, pari intervallo inter se distantibus instructæ. Unicum frustulum tantum vidi.

Diam. observ. 50; crass. 20 μ.

This rare form of *Coscinodiscus lacustris* may possibly constitute the genus *Perithyra* Ehr.

Var. TYMPANIFORMIS, n.var. (Pl. v., f.30)

Cellulæ a latere cingulato latissimæ, sæpe rectangulares; lateribus planis vel modice convexis, in medio interdum levissime inflatis, nec undulatis. Valvæ margine distinctâ, granulis marginalibus nullis.

Diam. observ. 40-54; crass. 25-26; lat. zonæ 12 μ.

Very broad in girdle-view, rectangular, the angles sometimes sharp, sometimes just rounded off; the sides flat, not undulated, but occasionally a little inflated towards the centre.

Var. IRIS (Heribaud & Brun). (Pl. v., f.31).

Diam. 50-70; crass. centr. 16, c. infl. unic. 22, c. infl. binis. 28 μ.

This answers exactly to *Cyclotella Iris* Heribaud & Brun, Diat. Auvergne, Pl.vi., f.1, 3, when allowance is made for the latter being fossil. The outer zone of the valve is striate, with coalesced puncta, one line to each marginal granule, and one intermediate; in the central area, the puncta of the striæ are distinct. The total breadth (*crass.*) across *both* inflations in girdle-view is just about the same as that in var. *tympaniformis*. In quantity, alive (9).

Lismore, type (1, 2, 7, 11, 12, 13, 21); var. *pellucidus* (7, 11); var. *stellatus* (11); var. *denticulatus* (7, 12); var. *papillatus* (6); var. *tympaniformis* (12); var. *Iris* (7, 9, 12).

MYXOPHYCEÆ.

Genus ANABÆNA Bory.

ANABÆNA OSCILLARIOIDES Bory.

Cell. carent.; heterocyst. oblong., long. 6, lat. 5; sporis oblongis vel cylindraceis, apicibus rotundatis, immaturis long. 9-12, lat. 6; maturis long. 15-23, lat. 7-8 μ.

Lismore, swamp (10); not noted in river.

Forma TORULOSA, n.f.

Fila torulosa diam. 4 μ, cell. truncato-globosis; heterocyst. sphæricis vel ovalibus, diam. 6 μ.

Lismore (2*b*). Cum var. *cylindraceâ*.

Forma CIRCINALIS, n.f.

Fila circinalia, diam. 5; cell. sphæricis, ovalis vel truncato-globosis; heterocyst. sphæricis, diam. 5; ovalibus, long. 7, lat. 6 μ.

Lismore (3). Cum var. *cylindraceâ*

Var. CYLINDRACEA, n.var. (Pl. vi., f.1).

Fila diam. 4-6 (7), apicibus attenuatis; *cellulis quadratis vel cylindraceis*, alt. 2-8, plerumque 4-6, endochromâ homogeneâ vel vacuolatâ, Heterocystidibus sphæricis, diam. 6 ; oblongis vel ovalis, long. 6-8, lat. 5-7; aut cylindraceis, long. 6-10, lat. 5-6. Sporis oblongis vel cylindraceis, long. 12-16, lat. 5-10 μ.

Lismore (2*a*, 2*b*, 12, 16).

Differs from var. *stenospora* Born. et Flah., only in the shape of the cells and the breadth of the spores, the latter, except when immature, having the dimensions of the type. The dimensions given above for the spores are the greatest noted in this district; round Sydney, I have observed spores up to 34 × 11 μ, very rarely, however. A torulose form of this variety, all dimensions agreeing, was also observed there (at Rookwood). *Anabæna Volzii* Lemm., Dr. Volz ges. süsswass., p.153, T.xi., f.4, 5, 20, is a form of this species distinguishable from var. *cylindracea* only by its barrel-shaped spores. I have found it at Canley Vale in company with the type (in fruit). A var. *Novæ Zelandiæ* Lemm., Reise n.d. Pacific, p.355, has very narrow cylindrical spores 3 μ broad and 16 μ long, but the cells are spherical and smaller, diam. 2-3 μ.

Genus NODULARIA Mertens.

NODULARIA SPUMIGENA Mertens. (Pl. vi., f.2).

Fila diam. 8; cell. veg. alt. 2-4, plerumque 2; heterocyst. depressis, diam. 8, alt. 4-8; sporis immaturis diam. 8, alt. 4, maturis diam. 8-9, alt. 6-7 μ.

Coraki, river-bank near Commercial Hotel (29)

The sheath was evident. There is, I think, no doubt that the appearance generally referred to in descriptions of the *Lyngbyeæ* as "trichomata ad genicula constricta" is due to the formation of a cellulose ring on the sheath, opposite the junction of the cells. In the projecting sheath of a broken filament in the above, they were plainly visible. In large forms, they develop into true septa across the sheath distinct from the cells themselves. Cf. Sydney Water-Supply, Pl. lvi., f.17.

Genus Plectonema Thuret.

Plectonema Nostocorum Bornet.

Fila. diam. $1\frac{1}{2}$; cell. alt. 2-4 μ.

Lismore (30).

Colour very pale blue, not yellow-green as in Gomont, but in this country yellow-green forms of generally pale blue species are not at all uncommon. I consider that the two colours are practically interchangeable. Filaments very little branched, sheath distinctly observed. In the case of trichomes which had been forced from the sheath, I noted, on more than one occasion, a very interesting phenomenon. The terminal cells, one by one, broke away, and after a short pause became motile. In some instances a portion of the trichome, containing several cells, became disconnected first, and then broke up. The cells thus set free do not move like *Vibrio* or *Bacillus*, but fly through the water, spinning rapidly round their shorter axis. By examination of the base of the æruginous stratum of *Phormidium corium*, with which the *Plectonema* was intermingled, it could easily be seen that the filaments of the latter were originally sessile. Hence these motile cells evidently settle down and form new filaments.

Genus Oscillatoria Vaucher.

Sheath always present, but generally very delicate. In all the species of Oscillatoria mentioned below, I clearly demonstrated the presence of a sheath—repeatedly in the case of *O. splendida* and its various forms. If a fragment of the stratum (or even a drop of water in which filaments are present in any quantity) be thoroughly *mashed up* on a glass-slip with the thumbnail, the sheath can generally be detected, either as a minute tag at the angles of a broken filament, or as a faint projecting tube, or as a connecting link between two trichomes on the two halves of a bent filament. It seems doubtful, therefore, whether there is any valid reason for retaining the genus *Lyngbya*. Cf. Gomont's remarks, Monog. d. Oscill., ii., pp.92, 93.

Oscillatoria splendida var. attenuata W. & G. S. West.

Fila diam $2\frac{1}{2}$-3; cell. disjunctis, alt. 4-10 μ.

Lismore (20*b*). Cum formâ typicâ.

Fila diam. $2\frac{1}{2}$-3; cell. conjunctis, alt. 4; cell. apic. long. 8-20, lat. 1-$1\frac{1}{2}$ μ.

Lismore (12, 13, 20).

O. splendida Grev., (*O. leptotrichà* Kütz., in Möbius, Austral. Süssw., p.449, f.22; Bailey's Bot. Bull. vi.) is common in rivers and creeks here, but the type-form, as in Gomont, l.c., T.7, f.7, 8, is very rare. I have only once seen it. The colour of *O. splendida* in all its forms is a characteristic pale blue, hardly ever greeny-blue, and the filaments very translucent except in var. *amylacea*. The cells are occasionally disjoined, and the two minute granules at each side of the septa, as figured by Gomont and W. & G. S. West, are very rarely found here. (Pl. vi., f.3).

Var. limnetica (Lemm.) mihi. (Pl. vi., f.4).

Fila ut in formâ typicâ vel in var. attenuatâ, dissepimentis autem utrinque granulis magnis singulis ornatis.

Diam. $1\frac{1}{2}$-2; cell. alt. 3-10, sæpe 8 μ; apicibus rotundatis vel modice attenuatis.

Lismore (13); with var. *amylacea* in *Lyngbya* stratum (26).

Diam. $1\frac{1}{2}$-3; cell. alt. 6-10, sæpe 8 μ; apicibus attenuatis subcapitatis diam. $1\frac{1}{2}$ μ.

Coraki, river-brink, with var. *amylacea* in *Spirulina* stratum (27).

In this country, forms of *O. splendida*, if granulate at all, almost invariably have a large single granule at each side of the dissepiments. I have only once seen it otherwise. That these *are* forms of *O. splendida*, is evident, as they often possess the characteristic apex of var. *attenuata*. In sample No.153, from Canley Vale, near Sydney, a pure growth of this kind is preserved, filaments diam. 2 μ, cell. alt. 3-6 μ, sheath distinctly observed, and many of the filaments are twisted exactly as in *Lyngbya perelegans* Lemm., Volz ges. süsswasseralg., T. xi., f.14.

In this var. *limnetica* (1898) should be included all Lemmermann's granulate *Lyngbyæ*, viz., *L. gloiophila*, Reise n.d. Pac. p.355 (1899); *L. perelegans*, l.c. (1899); and *L. bipunctata*, Forsch. Biol. Stat. z. Plön, T. 2, f.48 (1900). These differ from one another very slightly, and that, too, only in the breadth of the filament and length of the cells, points which are valueless for the formation of even distinct variations when the general characteristics are identical. From a note by G. S. West, Third Tanganyika Exp., p.175, it would appear that *L. Nyassæ* Schmidle, should be included here as a synonym also; it has the attenuate and capitate apex of the type.

Var. BACILLIFORMIS, n.var. (Pl. vi., f.5).

Fila clare cærulea, diam. $1\frac{1}{2}$ (vaginâ observatâ) cellulis disjunctis, alt. 6 μ, utroque polo granulis magnis singulis ornatis.

Lismore (2*a*).

Var. AMYLACEA, n.var. (Pl. vi., f.6).

Fila pallide cærulea, dissepimentis indistinctis rarissime cernendis. Protoplasma homogeneo amylo diffuso spissum.

Diam. 2-3 μ, cell. haud visibilibus, apicibus rotundatis.

Lismore (12, 21), in *Lyngbya* stratum (26).

Diam. 2 μ, et basi affixa et libera.

Lismore (16).

Diam. $2\text{-}2\frac{1}{2}\mu$ (vaginâ observatâ); cell. alt. 4-8 (rarissime ad 12 μ), apicibus attenuatis nonnunquam capitatis etiam vel subcapitatis, dissepimentis interdum sed rare cernendis.

Coraki, river-brink, in *Spirulina* stratum (27).

I have had this form under observation for years in Sydney, where it generally occurs in almost every mixed gathering of freshwater algæ. Its colour and size had already connected it in my mind with *O. splendida*, and this became a certainty by finding it, in this district, with the characteristic apical cell of var. *attenuata*, and by its close association with the granulate forms. The protoplasm is opalescent, with diffused amylum, so that the dissepiments are generally quite hidden, and the filaments very different in appearance from the transparent filaments of the type. Var. *limnetica* and all other granulate variations are formed from this one by the agglomeration of the diffused amylum into granules at the septa, thus leaving the protoplasm clear and pellucid. The apices are generally truncate or rounded, but this is the case to a greater or less extent with all the forms of *O. splendida.*

Forma CLARESCENS, n.f. (Pl. vi., f.7).

Fila diam. 2-3, apicibus rotundatis, cell. alt. 4 μ, granulis minutis singulis, utrinque ad dissepimenta; *et dissepimentis et granulis difficile cernendis* ob protoplasma amylo spisso.

Lismore, in *Lyngbya* stratum (24).

Forma (Pl. vi., f. 8).

Fila minutissima incipientia, epiphytica vel sessilia, basi affixa. Cytoplasma pallide cæruleum homogeneum.

Long. fil. incip. 10, 12, 14, 17, 18, 50; lat. 2-4 μ.

Lismore (13, 16, 17).

These incipient filaments were noted in fresh samples both epiphytic on *Oedogonium*, and sessile on flocculent matter. They also made their appearance on the sides of glass-jars in which samples were kept, *vide* Pl. vi., f.8*c*, where green cells have been deposited first, and these incipient *Oscillatoria* filaments have become epiphytic upon them. They must, therefore, be the outcome of motile cells or of micro-zoospores (see note under *Plectonema, supra*). They certainly develop into filaments of var. *amylacea*, Pl. vi., f.8*d*.

OSCILLATORIA TENUIS Ag. (Pl. vi., f.9).

Fila diam. 9 μ, cell. alt. 4 μ. Cf. Gomont, Pl.7, f.3.

Casino (14).

Var. CHLORINA, n.var. (Pl. vi., f.10).

Fila clare luteo-viridia, diam. 7 μ, vaginâ observatâ tenuissimâ; cellulis disjunctis alt. 3-4 μ; dissepimentis haud granulatis.

Lismore (22).

Trichomata diam. 5 μ ad genicula constricta, cellulis conjunctis alt. 4 μ. Dissepimentis haud granulatis.

Casino (14).

Genus Lyngbya Ag.

Lyngbya Lismorensis, n.sp. (Pl. vi., f.11).

Stratum fusco-olivaceum. Fila semper recta, margine glabra, pallide griseo-viridia, translucentia; apicibus attenuatis, interdum calyptrâ instructis. Cellulæ apicales conicæ vel rotundato-conicæ, rarius capitatæ, plerumque ad extremos membranâ incrassatâ. Vaginæ achroæ tenuissimæ. Trichomata ad genicula haud constricta, dissepimentis crassis, plerumque pellucidis glabris, interdum minute granulatis. Cytoplasma homogeneum translucens.

Diam. fil. 7-9, sub calyptrâ 4; cell. alt. 4-8, sæpe 6 μ.

Lismore, on curbstone near Commercial Hotel(26), river-water.

Diam. fil. 6-8, cell. alt. 4-8 μ.

Lismore, river (12, 13).

Var. nigra, n.var. (Pl. vi., f.12).

Fila obscure griseo-cærulea vel obscure griseo-viridia; apicibus sæpe late-rotundatis. Cetera ut in formâ typicâ.

Lismore, horse-trough near Gov. Savings Bank (30, 34).

The characteristic points of *L. Lismorensis* are the pale (or, in var. *nigra*, dark) grey colour of the filaments, *flashed* with pale green or pale blue, this latter point especially noticeable when the filaments are slightly out of focus. Also the quadrate cells, with their broad pellucid dissepiments, and the finer and fainter septa which sometimes alternate with the others, and are often to be noted just starting from the margins. The tips of the filaments, when fully formed, are capitate or calyptrate; but such are very rare, and conical tips, with the calyptra in process of formation, are more common. The broadly rounded ends often seen, are merely the result of broken filaments, and are not typical. Separated on a watchglass, in the mass the filaments are of a dull olive-green.

Genus Phormidium Kütz

Phormidium tenue (Menegh.) Gomont. (Pl. vi., f.13).

Diam. fil. 1-2; cell. alt. 2-6, plerumque 3-4, raro 8-10 μ.

Lismore (2, 2*b*, 12, 13, 18); Coraki, river-brink, with *Spirulina* (27), and *Nodularia* (29).

Diam. fil. $2\frac{1}{4}$; cell. alt. 2-6; sporâ immaturâ sphæricâ diam. 4; sporâ maturâ oblongâ, long. 8, lat. 4 μ.
Lismore (13).

Var. CHLORINA, n.var.

Trichomata pallide luteo-viridia; diam. fil. 1 μ; cell. alt. 3-6 μ.
Casino (14).

Phormidium tenue occurred sparsely in a considerable number of samples, and in some quantity in Nos.2 and *2b*, but in no case was it in the *Phormidium* state. This is also my experience with gatherings made near Sydney, where I found it only once in the agglutinated condition, viz., in an open drain in Park Rd., Auburn (No.48, N.H.S.). I am of the opinion that the *Phormidium* state is merely an accidental condition brought about by exposure of a stratum to the air and sun. A filament with a spore, as given in Pl.vi., f.13*c*, was noted also at Auburn (Nov. 16th, 1909). The spherical cell is not a heterocyst, but an immature spore.

PHORMIDIUM FRAGILE (Menegh.) Gomont. (Pl. vi., f.14).

Diam. fil. 2-$3\frac{1}{2}$; cell. alt. 2-3 μ.
Lismore (12).

Generally found sparingly in mixed gatherings as short filaments, here and around Sydney. Meneghini made it an Anabæna, and here it was found in company with *A. oscillarioides* var. *cylindracea* (Pl. vi., f.1) with cells of the same shape, diam. 4-6 μ. I should not be surprised if it turned out to be the transition-stage between the two genera. I have never found it either in the *Phormidium* condition. Gomont makes it a marine form.

Genus SPIRULINA Turpin.

SPIRULINA MAJOR Kütz. (Pl. vi., f.15).

Spira diam. 4; anfr. 4-6 inter se distant.; trich. diam. $1\frac{1}{2}$ μ.
Lismore (12), loose filaments.
Spira diam. 4; anfr. 2-3 inter se distant.; trich. diam. $1\frac{1}{2}$ μ.
Coraki, river-brink (27), mucous stratum.

SPIRULINA LAXISSIMA G. S. West. (Pl. vi., f.16).

Spira laxissima diam. 4; anfract. 10-15 inter se distant.; trich. diam. 1-1¼ μ.

Lismore (20), in *Lyngbya* stratum (26).

A very rare *Spirulina*, only known besides from Tanganyika. Generally found here in short pieces, 30-80 μ long. Cf. G. S. West, Third Tanganyika Exp., p.178, Pl.9, f.6.

SPIRULINA CORAKIANA, n.sp. (Pl. vi., f.17).

Trichomata angustissima in spiram laxissimam regularem diametro 2 μ æqualiter contorta; anfractibus 6-10 inter se distantibus; cytoplasmate pallide ærugineo et homogeneo. Crass. trich. 0·8 μ.

Lismore (12); Coraki, with *Spirulina major* (27).

Genus MERISMOPEDIA Meyen.

MERISMOPEDIA PUNCTATA var. OBLONGA, n var. (Pl. vi., f 18).

Cellulæ oblongæ, long. 3, lat. 2 μ.

Lismore (2).

MERISMOPEDIA ELEGANS A.Br. (Pl. vi., f.19).

Cœnob. long. 300, lat. 200; cell. sphæric. diam. 4-5, oblongis long. 6-7, lat. 4-5 μ.

Lismore (9, 18).

Cœnobia very large and membranous. Cells very numerous, 1024 and 2048 actually observed (32 rows × 32 and 64 rows × 32), closely approximated, only 1-2 μ between, pale blue or pale green, oblong, constricted or spherical according to stage of division. Syn., *M. nova* Wood, cf. Tilden, Minnesota Algæ, i., pp.42, 43.

Genus CŒLOSPHÆRIUM Näg.

CŒLOSPHÆRIUM KUETZINGIANUM Näg. (Pl. vi., f.20).

Cœnob. long. 40, lat. 36; cellulis clare cæruleis, diam. 3 μ.

Lismore (20).

Var. PUNCTATA (Näg.) mihi. (Pl. vi., f.21).

Cœnob. diam. 6-16, cell. diam 2 μ.

Lismore (16).

Syn., *Gleocapsa punctata* Näg., Gatt. Einz. Alg., T. i., f.F6. These are the younger stages of development of *Cœlosphœrium Kützingianum*. In gathering (16) there were quantities of them, the growth from a single cell being easily seen (Pl. vi., f.21). This cell is indistinguishable from *Merismopedia punctata* (also noted in the river), and I consider, therefore, that *Cœlosphœrium* is a *facies* of *Merismopedia*, with a globose cœnobium instead of a flat one. How this is accomplished (the plant still retaining its division in one plane) is very simple. The four cells resulting from the division of the original cell in two directions, arrange them at the angles of an imaginary tetraëdron, and each cell thenceforward divides regularly in its own plane. The same two modes of development occur in *Tetraëdron lobulatum*, where both flat and tetraëdral forms are produced by growth from the same flat cell.

CHYTRIDIACEÆ.

Genus Trochisia Kütz.

Trochisia hirta var. elliptica, n.var.

Cellulæ irregulariter ellipticæ. Cytoplasma hyalinum.

Long 58-60, lat. 36-40, spin. long. ad 12 μ

Lismore, on decaying cells of *Spirog. maxima* (20). (Pl. vii., f.1).

Cf. De Bary, Conj., T. i., f.6. This is a half-grown form of *Tr. hirta.*

Formæ valde immaturæ. (Pl. vii., f.2).

Cellulæ minimæ globosæ, primum glabræ deinde minute denticulatæ. Cytoplasma hyalinum.

Diam. cell. 8-14 μ, spin. long. ad 1 μ.

Lismore, on decaying cells of *Spirog. maxima*(16); on decaying specimens of *Penium australe* and *Doc. trabecula*(12).

Cf. Reinsch, De Spec. generibus, T.5D, f.iii. 3, whose figure works out at diam. 20 μ. On a single *Spirogyra* cell, 30 were observed, each surrounded by the excavated (?), circular space characteristic of *Trochisia, in situ.* Six were noted also on one specimen of *Pen australe.* I have observed *Tr. hirta* also in *Eremosphœra viridis.* Wille's excellent account and figures of a variation of *Tr. granulata* (Studien über Chlorophyceen, 1900, ii.) leave no doubt that *Trochisia*, under certain circumstances, develops chlorophyll, living and reproducing itself in the manner of the Algæ. Nevertheless, though I have noted *Tr. hirta*, *Tr. granulata* and *Tr. reticulata* from a number of localities in this country, the cytoplasm has been invariably hyaline, as was also the case in the forms observed in these samples. Add to this their development, as shown in the *formæ immaturæ* above, and the fact that they are always found on decaying cells, and I can only conclude that the forms of *Trochisia* are essentially saprophytic in character. The genus seems to me nearest to *Chytridium* of all the algal fungi. The minute immature forms of the green algæ may occasionally be pale blue, but never hyaline, as in this plant.

TROCHISIA VERRUCOSA, n.sp. (Pl. vii., f.3).

Cellulæ globosæ vel ellipticæ, verrucis quadratis dense obtectis. Cytoplasma hyalinum.

Long. 58, lat. 34; verrucæ long. 2-3 μ.

Lismore, on decaying *Spirog. maxima* (20).

Genus CHYTRIDIUM A.Br.

CHYTRIDIUM GREGARIUM Nowakowski. (Pl. vii., f.4).

Cell. long. 32-48, lat. 26 μ.

Lismore, in dead Rotifer (16).

Cf. Nowakowski, Kentnn. d. Chytridiaceen, i., p.77, T.iv , f.2.

CHYTRIDIUM AMPHORIDIUM, n.sp. (Pl. vii., f.5).

Cellulæ lageniformes; corpore globoso superne in collum angustum protracto. Cytoplasma hyalinum.

Long. cell. 12, corp. 7, coll. 5; lat. corp. 6, coll. 2 μ.

Casino, on *Hydrodictyon* (14).

Genus RHIZIDIUM A.Br.

RHIZIDIUM MYCOPHILUM A.Br. (Pl. vii., f.6).

Zoosporangia immatura, *subglobosa* diam. 7-10, cell. basal. (dauerspora) diam. 7-10, *pyriformia* long. 13-22, lat. 9-14, cell. basal. diam. 10-14. Zoosporangia matura ovata, long. 40, lat. 24, cell. basal. diam. 18; zoospor. diam. 6, flagell. long. 20-25; hyphæ lat. 1-2 μ.

Casino, on decaying *Hydrodictyon* (14).

Cf. Nowakowski, l.c., p.88, T. v., f.6-12, T. vi., f.1-5. He gives the size of the mature zoosporangium as, long.40, lat.25, zoospores diam. 5, dauerspores diam. 18-30 μ. The young zoosporangium is globose, becoming pyriform or ovate with growth; and, at the base, four rugæ form, disposed crosswise Occasionally these are found also in very young zoosporangia, in which case the latter are somewhat dome-shaped. The corrugations are not shown in Nowakowski's figures, probably because his specimens were growing freely in the mucus of *Chætophora*; this also accounts for many other differences of growth. In our specimens, growing, as they were, on decayed algal cells, the zoosporangia lie outside and the dauerspores and hyphæ inside the cell-wall, being connected by a minute pore. It would appear, therefore, that, in these cases, the zoosporangial cell forms first, pierces the cell-wall of the host, and gives rise to the mycelium and dauerspore within. The dauerspore evidently acts as a reservoir, gradually passing on its contents to the zoosporangium, for when the latter is mature, the dauerspore is always empty and the hyphæ atropied.

Rhizidium Spirogyræ, n.sp. (Pl. vii., f.7).

Zoosporangium maturum globosum; in speciminibus vacuis superne truncatum, oris levissime eversis; (cellulæ immaturæ sæpe plus minusve ovatæ); ad basin petiolo brevissimo instructum, dauersporis nullis.

Long. = lat. = 10-34 μ.

Lismore, on decaying cells of *Spirogyra maxima* (20).

Quantities of minute growing cells were noted also, from diam. 4 μ upwards, globose Very rarely, there is found a minute ($\times$ 3 μ) swelling where the dauerspore should be.

SCHIZOMYCETES.

Spirillum volutans.

In filament-form, and in active and non-motile spirals. The filamentous form looks like an *Oscillatoria* or *Lyngbya*. It is generally hyaline or very pale blue, and very lively, coiling and twisting until it breaks into short lengths. These remain quiescent for a short time, then gradually coil into non-motile spirals, which finally, after some spasmodic movements, become active. I have watched the whole process.

Lismore (3, 11, 12).

Var. MAXIMUM n.var. (Pl. vii., f.8).

Long. s. flag. 50; diam. anfract. 14, diam. fil. $1\frac{1}{2}\mu$. Anfractibus 3; in extremis flagello distincto praeditum.

Casino (14).

SPIRILLUM TENUE Cohn. (Pl. vii., f.9).

Long. s. flag. 10; diam. anfr. 3, diam. fil. 1μ. Anfract. 2.

Lismore (20); Coraki, river-brink, in *Spirulina* stratum (27).

SPIRILLUM LAXISSIMUM n.sp. (Pl. vii., f 10).

Trichomata brevissima hyalina in spiram regularem laxissimam contorta; anfractibus semper singulis.

Long. s. flag. 4-8; diam. anfr. 2-3; diam. fil. $\frac{3}{4}$-1μ.

Long. s. flag. 10-16; diam. anfr. 3-4; diam. fil. $1\frac{1}{2}\mu$.

Lismore (16), both forms together in quantity.

I have always taken this to be *Spirillum undula* Cohn, and indeed that name would describe the plant very well. However, reference to Q. Journ. Micr. Sci., n.s., Vol. xiii., Pl. v., shows that *Sp. undula* (f.20) cannot be distinguished from *Sp. tenue* Ehr. (f.19), and must be considered, therefore, as a synonym of the latter. Note that the figures of *Sp. undula* and *Bacillus subtilis* in Strasburger's Botany (Eng. ed., p. 333, f. 252*d* and f.254*b*) are entirely different from those given by Cohn, *l.c.*, which, the writer says, "must furnish the basis for all future nomenclature."

[OSCILLATORIA AMPHIBIA Ag.]

Fila glabra, diam. 1-3 μ, dilutissime cærulea pæne hyalina, granulis sparsis primum hyalinis, deinde nigrescentibus impleta.

Lismore (18, 27), Casino (14). Plentiful in (18).

Var. MAJOR, n.var.

Diam. 4μ. Lismore (18), cum priori multo rarius

Var. MAXIMA, n.var. (Pl. vii., f.11).

Diam. 8 μ. Lismore (2), rarissime.

Var. ASPERA, n.var. (Pl. vii., f.12).

Fila dilutissime cærulea vel achroa, minute aspera, granulis atris sparsis projicientibus, diam. 1-2 μ.

Casino (14). Plentiful.

Geddes and Ewart, *l.c.*, have shown, though not by name, that *Oscillatoria amphibia* is the sporangial state of *Spirillum.* It is developed from the same filamentous form which gives rise to *Spirillum volutans* and *Sp. tenue.* The scattered granules, at first hyaline, and later deep black, are loculi full of spores, which are set free and develop into *Sp. undula.* These three Spirilla are, of course, merely polymorphic forms, one of the other. In var. *aspera*, the granules project through the cell-wall.

BACILLUS SUBTILIS. (Pl. vii., f.13).

Fila diam. 1-2 (vulgo $1\frac{1}{2}$); cell. alt. 5-10, vel. 10-22 μ.

Lismore (6, 7, 20), Casino (14), Kyogle (41, 45).

Was more in evidence in these gatherings than I have ever known it before. The cells, in the filaments, are generally disjointed, but in (41) short filaments were noted with contiguous cells. *Bacterium termo* and *Vibrio serpens* were also met with. Two curious zooglœa stages of the former are figured(Pl.vii.,f.14).

Fauna.

ENTOMOSTRACA.

MACROTHRIX SPINOSA King. (Pl. viii., f.1).

Long. carap. 530, lat. 330; long. caud. proc. 142, set. 124; long. antenn. 105; spin. ad. 70 μ.

Lismore (11, 12, 13, 15), Casino (14).

Common in the river. The caudal processes often end abruptly, each terminating in a pair of long setæ. Noted with winter eggs in December and January (midsummer). Dorsal edge of the carapace minutely serrulate. It is doubtful, therefore, whether the species is distinct from *M. laticornis* (Jurine), as Sars(Austral. Cladocera, ii., p.26) makes this the chief point of difference.

Var. DENTATA, n.var. (Pl. viii., f.2).

In capite glabra minute autem serrulata; a fronte et a tergo dentibus nec spinis instructa.

Lismore (16, 20).

Cyclops quadricornis, *Diaptomus gracilioides*, *Alona clathrata* Sars, and *Alona lævissima* Sars, were also observed.

INFUSORIA.

TRACHELOMONAS VOLVOCINA var. PELLUCIDA, n.var.

Lorica achroa, forma minuta, diam. 8-10 μ.

Lismore (1, 8). Common. (Pl. viii., f.3).

The type, diam. 17 μ, with deeply yellow-brown lorica, noted at Casino (14), rare.

TRACHELOMONAS OVALIS, n.sp. (Pl. viii., f.4).

Lorica ovalis vel oblonga, collo nullo, perfecte glabra, achroa vel luteo-fusca. Long. 30, lat. 22 μ.

Casino (14), with *Tr. hispida.*

LEPOCINCLIS STEINII var. SUECICA Lemm. (Pl. viii., f.5).

Long. corp. 26-32; lat. 11-12, ap. 3; long. caud. 3 μ.

Lismore (22), Casino (14).

Cf. Lemmermann, Plankt. Schwed. gewass., T. i., f.20.

Var. AUSTRALICA, n.var. (Pl. viii., f.6).

Forma latior, corpore late-ovali, caudâ brevi, oblique spiraliter striata.

Long. corp. 32, lat. 24; long. caud. 8 μ.

Lismore (22). Common.

Neither form was noticeable in the freshly gathered material, being present only as minute vegetative resting cells, unrecognisable. After the sample had been standing for several months (in a corked phial without preservative), exposed to a strong diffused light, they were found in numbers, alive and active, having developed in the bottle.

MENOIDIUM PELLUCIDUM var. INCURVUM (Fresenius).

Long. 16, lat. 5 μ. Common. (Pl. viii., f.7).

Lismore (13). Cf. Daugeard, Les Eugléniens, p.151, f.46.

Var. CLAVATUM, n.var. (Pl. viii., f.8).

Forma clavata, parte superiore elliptico-lanceolata, protoplasmate granulato, apice angusta truncata; parte inferiore angusta in caudâ protracta, protoplasmate homogeneo; flagello recto.

Long. 40, lat. 6, ap. 2, caud. 1 μ.

Lismore (12, 13). Cum priori.

Looks like *Peranema (Astasia) trichophorum* var. *pusillum* Stokes, but the motion is that of *Menoidium*.

Other interesting forms of Infusoria noted were, *Mastigamœba longifilum* Stokes, *Anthophysa vegetans* Stein, *Dendromonas virgaria* Stein, *Cothurnia parallela* Maskell, and *Operculata elongata* Kellicott.

RHIZOPODA.

DIFFLUGIA CASINOENSIS, n.sp. (Pl. viii., f.9).

Lorica subglobosa, in ambitu late-ovalis, ore lato margine levissime recurvata. Membrana glabra pellucida, frustilis *Cocc. placentulæ* confirmata.

Long. 48, lat. 40, or. 28 μ.

Casino (14).

DIFFLUGIA ACUMINATA var. LEVANDERII mihi. (Pl. viii., f.10).

Lorica angusta lateribus subparallelis, extremitate posteriore acuminata in caudâ brevi protracta. Membrana granis arenæ confirmata.

Long. 190, lat. 60, or. 48 μ.

Casino (14). Cf. Levander, Wasserfauna, T. i., f.7.

Var. BACILLIFERA, n.var. (Pl. viii., f.11).

Long. 110, lat. 70, or. 40 μ.

Lismore (13).

DIFFLUGIA RICHMONDIÆ, n.sp. (Pl. viii., f.12).

Lorica ovalis, apice truncato, ore minuto circulari. Membrana granulis rugosa, dilute luteo-fusca. Pseudopodia crassa.

Long. 14, lat. 12, lat. oris. 3 μ.

Lismore (2). Common.

Difflugia globulosa, *D. lobostoma*, *Sphenoderia lenta*, and *Trinema enchelys* were also observed. The most common species, however, was *Centropyxis aculeata*, generally var. *ecornis*.

EUGLYPHA ALVEOLATA var. HAMULIFERA, n.var. (Pl. viii., f.13).

Forma laminis circulari-hexagonis minime marginibus transilientibus ornata.

Long. 44, lat 24, oris 8 μ.

Lismore (13). Plentiful.

Var. LÆVIS (Perty) mihi. (Pl. viii., f.14).

Forma minuta, parte posteriore rotundata vel acuminata; ore dentibus truncato-conicis 6 (visis 4) circumcincto; membranâ glabrâ sine notis spinisque.

Long. 30-34, lat. 16, or. 8-10 μ.

Lismore (1, 6). Plentiful

ARCELLA PAPYRACEA, n.sp. (Pl. viii., f.15).

Lorica a fronte visa circularis; ore circulari, serie unicâ punctorum circumcinxo; a latere crateriformis, margine levi, ore recesso. Membrana glabra sine notis, texturâ papyraceâ, dilute luteo-fusca.

Diam. 60-80, crass. 32; lat. oris. 20-30 μ.

Casino (14).

The membrane is without the usual markings, semitransparent, and cloudy like thin straw-paper. *Arcella vulgaris* and *A. discoides* were also present, the latter very common.

ACTINOPHRYS SOL var. SIMPLEX (Schaudinn) mihi.

Diam. corp. 7-22, pseudopodia long. ad 25 μ.

Lismore (7, 12).

Syn., *Acanthocystis simplex* Fr. Schaudinn, Mém. Acad. St. Pétersbourg, 1893, p.11, f.8; (diam. 15-22 μ). The figure given by Schaudinn shows quite plainly the characteristic *lumpy*, sharp-pointed pseudopodia of *Actinophrys* and *Actinosphærium*. The pseudopodia of *Acanthocystis* are of quite a different kind, being smooth and bacillar, with or without a minute knob at the end, or minutely bifid. In the specimens I noted, the pseudopodia were smooth and very faint, in the smallest (diam. 7 μ) only 15 μ long, but even so, they had the characteristic attenuate shape. (Pl. viii., f.16).

Var. Eichhornii mihi

Diam. corp. 80-240; pseudopodia long. ad 160 μ.

Lismore (16).

Actinosphærium Eichhornii is merely the mature form of *Actinophrys sol.* Minute forms of the latter (var. *simplex* Schaudinn, *supra*) have solid bodies; in well grown specimens of *Actinosphærium*, the whole is composed of large cells; while, in the type, the body is a mass of small cells, with larger ones making their appearance on the surface. The pseudopodia are similar in every case.

Amœba verrucosa. (Pl. viii., f.17).

Long. circ. 50-60 μ. The usual size in this country.

Lismore (11, 12).

With var. *quadrilineata* (Carter) mihi (Syn. *A. quadrilineata* Carter), showing four longitudinal lines. There are always four, neither more nor less. The contractile vesicle is generally very distinct in this species, as it only discharges at considerable intervals. It is almost always at the extreme end.

Var. limax (? Duj.) mihi. (Pl. viii., f.18).

Long. circ. 30, lat. circ. 10 μ.

Kyogle (41). Cum prioribus duabus.

I consider this a minute form of *A. verrucosa*, on account of its mobility, its straightforward movement, the distinct contractile vesicle, and the broad edging of ectosarc at the anterior end, all of which are characteristic of that species. In shape, it is cuneate.

Var. maxima, n.var. (Pl. viii., f.19).

Formæ typicæ consimilis sed maxima. Long. 120, lat. 90 μ.

Casino (14). Twice as large as the type.

Amœba radiosa var. minutissima, n.var.

Diam. max. pseudop. incl. 20-30, diam. corp. 4-8 μ.

Lismore (7, 12, 15).

The usual size is considerably larger than this. These minute specimens retain the characteristics of the species, which is quite distinct. The cytoplasma is much more solid than in *A. proteus* or *A. verrucosa*, and the shape always radiate. The contractile vesicle is small, with a long systole, and sudden discharge. (Pl. viii., f.20).

Var. STELLATA, n.var. (Pl. viii., f.21).

Forma pseudopodiis longissimis angustissimis filiformibus.

Diam. corp. circ. 50, pseudopodia long. ad 150 μ.

Lismore (12).

The pseudopodia are of clear ectosarc, very narrow, often quite filiform, and always blunt at the ends. They are often more or less stable, and are moved about bodily like the tentacles of *Hydra*.

Amœba proteus, *Vampyrella lateritia*, *Pamphagus mutabilis*, *Clathrulina elegans*, *Cochliopodium bilimbosum*, and *Acanthocystis* sp. were also found.

EXPLANATION OF PLATES II.-VIII.

Plate ii.

(In figures of *Volvox*, the flagella have been omitted).

Fig.1.—*Chlamydomonas globulosa* Perty; *p.* pyrenoid, *gr.* granule (×704).

Fig.2.—*Volvox aureus* Ehr., part of the wall of the cœnobium, showing connective filaments; *p.* pyrenoids (×528).

Fig.3.—*Volvox aureus*, cell; *p.* pyrenoid, *gr.* granule, *st.* stigma (×1056).

Fig.4.——————— one of the parthenogonidia (×704).

Fig.5.—*Volvox Bernardii*, n.sp. Family of eight cœnobia (×235).

Fig.6.——————— a younger cœnobium (×528).

Fig.7.——————— with crowded cells (×528).

Fig.8.——————— one of the parthenogonidia of fig.7 (×704).

Fig.9.——————— a young cœnobium, with few cells(×528).

Fig.10.——————— with oogonia (×235).

Fig.11.——————— one of the oogonia (×1056).

Fig.12.—*Eudorina elegans* var. *Richmondiæ*, n.var., cell (×880).

Fig.13.—*Uva Casinoënsis*, n.gen. et. sp. (×1056).

Figs.14-15.—*Chlamydomonas* sp., (prob. *intermedia* Chod.), young non-motile forms; *p.* pyrenoid, *c.v.* contractile vesicle (× 1056).

Figs.16-17.—*Gleocystis*-forms of (probably) *Chl. intermedia;* 16, a homogeneous cœnobium which has got frayed out at the periphery, the cells, as a result, tending to be cordate; 17, a compound cœnobium with cells in pairs, head to tail (×352).

Plate iii.

Fig.1.—*Spirogyra Lismorensis*, n.sp. (×470).
Fig.2.—*Pen. australe* Rac., end-view of choroplasts (×352).
Fig.3.——— *globosum* var. *Wollei*, f. *maxima*, n.f. (×352).
Fig.4.—*Closterium acerosum* var. *angolense* W.&G.S.West, f. (× 264; (*a*), tip (×704).
Fig.5.———————— var. *Casinoënse*, n.var. (×704).
Fig.6.—*Cosmarium angulatum* f. *major* Grun. (×352).
Fig.7.———————— var. *conicum*, n.var. (*a*) + var. *subcucumis* (Schm.),(*b*),(×352).
Fig.8.———————— var. *subcucumis* (Schm.) (×352).
Fig.9.—*Cos. angulatum* f. *major* Grun., (*a*) + var. *subcucumis* (Schm.), (*b*) (×352).
Fig.10.——— *subcostatum* var. *Beckii* (Gutw.) W. & G. S. West (×704).
Fig.11.———————— var. *australe*, n.var. (×704).
Fig.12.——— *Blyttii* var. *Richmondiæ*, n.var. (×704).
Fig.13.————————var. *Casinoënse*, n.var. (×704).
Figs.14-16.—*Cos Seeleyanum* var. *elegans*, n.var. (×704).
Fig.17.—*Cos. magnificum* var. *fluviatile*, n.var. (×352).
Fig.18.——— *dentiferum* Corda (×235).
Fig.19.———————— var. *porrectum* (Nord.) (×352).
Fig.20.———————————— forma (×352).
Fig.21.———————————— (Nord.) (*a*), + var. *quadrum* (Lund.) (*b*) (×352).
Fig.22.———————— var. *sublatum* (Nord.) (×235).
Fig.23.—*Hydrodictyon reticulatum* var. *minimum*, n.var. (×704).
Fig.24.———————————— var. *nodosum*, n.var. (×175).
Fig.25.———————————— var. *Bernardii*, mihi (×70); (*a*) chloroplast very much magnified.
Fig.26.—*Pediastrum tetras* var. *integrum* (Näg.), development out of cœnobium of *Pedi. tetras* (×704).
Fig.27.———————— *Boryanum* var. *capitatum*, n.var. (×352).
Fig.28.—*Kirchneriella lunaris* var. *approximata*, n.var. (×704).
Fig.29.———————— var. *aperta* (Teiling) (×704).

Fig.30.————————— var. *contorta* (Schm.) (×704).
Fig.31.—*Geminella interrupta* var. *cylindracea*, n.var. (×704).
Fig.32.—*Gonatozygon Kinahani* forma (×704).

Plate iv.

Fig.1.—*Amphora coffæiformis* Ag. (×704)
Fig.2.———— *veneta* var. *grossestriata*, n.var. (×704).
Fig.3.————————————— long form (×528).
Fig.4.—*Cocconema tumidum* Bréb. (×528).
Figs.5-6.—*Navicula mutica* Kütz.(×1056).
Fig.7.—————————— var. *rhomboidea*, n.var. (×1056).
Fig.8.—————————— var. *ovalis*, n.var. (×1056).
Fig.9.—————————— var. *subhexagona*, n.var. (×1056).
Figs.10-12.—————————— var. *subcircularis*, n.var. (×1056).
Fig.13.——————————var. *Göppertiana* (Bleisch) (×1056).
Figs.14-15.—*Diploneis Boldtiana* var. *australica*, n.var. (×1056).
Fig.16.—————————— var. *ovalis*, n.var. (×1056).
Fig.17.—————————— var. *acuminata*, n.var. (×1056).
Fig.18.—*Amphiprora alata* var. *Holdererii* (Gutw.) mihi (×528).
Figs.19-20.—*Gomphonema augur* var. *rotundatum* (Ehr.) mihi (×704).
Figs.21-22.—————————— var. *angulatum*, n.var. (×704).
Fig.23.——————— *constrictum* var. *australe*, n.var. (×528).
Fig.24.——————— *triangulare*, n.sp. (×704).
Fig.25.—*Achnanthes calcar* var. *australis*, n.var. (×1056).
Fig.26.—————————— lower valve (×1056).
Fig.27.—————————— var. *pulcherrima*, n.var. (×1056).
Fig.28.—*Cocconeis placentula* var. *euglypta* (Ehr.) Cleve. (×1056)
Fig.29.—————————— var. *australica*, n.var. (×528).
Fig.30.—*Epithemia gibberula* var. *perpusilla*, n.var. (×1056).
Figs.31-32.—*Eunotia formica* var. *Richmondiæ*, n.var. (×528); (31*a*), apex in girdle-view (×704).
Figs.33-38.—*Synedra Lismorensis*, n.sp. (×704); (*a*), girdle-view (×704).
Figs.39-40.—*Surirella ovalis* var. *pinnata* (W.Sm.) Van Heurck (×704).
Figs.41-42.—————————— var. *Lewisii* mihi (×792).
Fig.43.—————————————— portion of the edge, showing incipient costa; much enlarged.

Plate v.

Fig.1.—*Surirella plana* G.S.West, forma (×528).
Figs.2-3.—————————— var. *algensis*, n.var.; (2), valve (×704); (3), girdle-view (×528).

Fig.4.—*Nitzschia paradoxa* var. *major* Van Heurck (×704).
Fig.5.———————— var. *perpusilla*, n.var. (×1056).
Fig.6.———— *vermicularis* var. *vialis*, n.var. (×352).
Fig.7.———————— var. *minuta*, n.var. (×704).
Fig.8.—*Tryblionella Hantzschiana* var. *minor*, n.var. (×704).
Fig.9.———————— var. *Victoriæ* (Grun.) mihi (×704).
Fig.10.———————— girdle-view (×704).
Fig.11.———————— edge in ¾-face; much enlarged.
Fig.12.———————— var. *calida* (Grun.) V. Heurck(×528).
Fig.13.———————— var. *ovata* (Lagerstedt) mihi; (*a*), girdle-view (×704).
Fig.14.———————— var. *australica*, n.var. (×528).
Fig.15.———— *cruciata*, n.sp. (×704).
Fig.16.—*Melosira varians* var. *moniliformis* (O.F.M.), semi-detached frustules in a short filament (×704).
Fig.17.———————— isolated cell dividing (×528).
Fig.18.—*Cyclotella Meneghiniana* Kütz., forma; (*a*), girdle-view (×704).
Fig.19.———————— var. *convexa* mihi; (*a*), girdle-view (×704).
Fig.20.———————— another form (×1056).
Figs.21-22.———————— var. *quadrata*, n.var.; (22), girdle-view (×1400).
Fig.23.———————— var. *brevistriata*, n.var. (×1056)
Fig.24.———————— var. *fluviatilis*, n.var. (×1056).
Fig.25.—*Diadesmis confervacea* var. *peregrina* (W.Sm.) (×704).
Fig.26.—*Hydrosera triquetra* Wallich (×352); (*a*), end (×704).
Fig.27.—*Coscinodiscus lacustris* var. *stellatus*, n.var. (×704).
Fig.28.———————— var. *denticulatus*, n.var. (×704).
Fig.29.———————— var. *papillatus*, n.var. (×352).
Fig.30.———————— var. *tympaniformis*, n.var. (×528).
Fig.31.———————— var. *Iris*(Herib.&Brun) mihi(×528).

Plate VI.

(All figures magnified 660 diameters unless stated otherwise.).

Fig.1.—*Anabæna oscillarioides* var. *cylindracea*, n.var.; (*a*) filament diam. 7μ one end, 5μ the other, with rounded apical cell, and a terminal heterocyst; (*b*) terminal heterocysts, two forms, (×1000); (*c*) filament with two forms of heterocyst; (*d, e*) cells quadrate and vacuolate, (*c, d, e*) show plainly the development of the heterocysts from globular to cylindrical; (*f*) spores; (*g*) cells with granular and homogeneous protoplasm in same filament; (*h*) minute filaments like this in profusion (16), outgrowth probably of isolated cells.

Fig.2.—*Nodularia spumigena* Mertens; (*a*) infertile filament with three forms of heterocyst; (*b*) with ripe spores; (*c*) with immature spores.

Fig.3.—*Oscillatoria splendida* var. *attenuata* W.& G.S.West.

Fig.4.———————————var. *limnetica* (Lemm.) mihi.

Fig.5.———————————var. *bacilliformis,* n.var.

Fig.6.———————————var. *amylacea,* n.var.; (*a, b, d*) rare forms of apex; (*c*) filament with sundered trichome, showing sheath and also the common type of tip.

Fig.7.—*Oscill. splendida* var. *amylacea* forma *clarescens,* n.f.; the markings hardly visible.

Fig.8.——————————— incipient filaments, outgrowth of motile cells; (*a*) on *Oedogonium* (×330); (*b*) on vegetable débris; (*c*) on previously deposited living cells; (*d*) becoming filamentous by growth.

Fig.9.—*Oscillatoria tenuis* Ag.

Fig.10.————————— var. *chlorina,* n.var.

Fig.11.—*Lyngbya Lismorensis,* n.sp.; (*a, b, c*) common and characteristic apices; (*d, e, f*) rare forms of tip; (*g*) broken filament showing sheath.

Fig.12.————————— var. *nigra,* n.var.; (*a*) with broad smooth dissepiments and fine incipient septa; (*b*) with granulate septa.

Fig.13.—*Phormidium tenue* (Menegh.) Gomont; (*a*) three forms of trichome in the same filament; (*b*) tip of a filament with contiguous cells; (*c*) a filament with spores.

Fig.14.—*Phormidium fragile* (Menegh.) Gomont; two sizes, cells showing the characteristic appearance of the protoplasm.

Fig.15.—*Spirulina major* Kütz.; two forms.

Fig.16.—————— *laxissima* G.S.West.

Fig.17.—————— *Corakiana,* n.sp.

Fig.18.—*Merismopedia punctata* var. *oblonga,* n.var.

Fig.19.—————— *elegans* A.Braun.

Fig.20.—*Cœlosphærium Kützingianum* Näg. (×500).

Fig.21.————————————— var. *punctata* (Näg.) mihi; (*a*) diam. 2μ; (*b*) $5\mu \times 2\mu$; (*c*) $5\mu \times 5\mu$; (*d*) tetraëdral form, diam. 6μ; (*e*) eight-celled cœnobium, diam. 8μ; (*f*) diam. 10μ; (*g*) diam. 12μ; (*h*) diam. 16μ: (*a*) to (*h*) show development of a young form of *Cœlosphærium Kützingianum* from the single cell. In profusion in No. 16, the above all noted in the same drop.

Plate vii.

Fig.1.—*Trochisia hirta* var. *elliptica*, n.var.(×330).

Fig.2.————— minute immature forms of growth, (*a*) smooth, (*b*) denticulate (×330).

Fig.3.———— *verrucosa*, n.sp. (×330).

Fig.4.—*Chytridium gregarium* Nowakowski, in carapace of a rotifer (×330).

Fig.5.—*Olpidium amphoridium*, n.sp., discharging (*a*) microzoospores, (*b*) a mass of spores (×660).

Fig.6.—*Rhizidium mycophilum* A.Braun, (*a*, *b*) immature forms, (*c*) mature, (*e*) extrusion of a mass of zoospores, (*d*) zoospores wriggling free (×330).

Fig.7.—*Rhizidium spirogyræ*, n.sp., (*a*) incipient forms, (*b*, *c*, *d*, *e*) discharged cells (all ×330); (*f*, *g*, *h*) other forms (×660).

Fig.8.—*Spirillum volutans* var. *maximum*, n.var. (×660). discharged cells (all ×330); (*f*, *g*, *h*) other forms (×660).

Fig.9.—————*tenue* Ehr. (×1000).

Fig.10.———— *laxissimum*, n.sp., (*a*) small form, (*b*) larger (×1000).

Fig.11.—[*Oscillatoria*] *amphibia* var. *maxima*, n.var. (sporiferous *Spirillum* filament) (×330).

Fig.12.————— var. *aspera*, n.var. (sporiferous *Spirillum* filament), (*b*) part with spore capsules, part without (×500).

Fig.13.—*Bacillus subtilis* Ehr., (*a*, *b*) in filament form, (*c*) free cells with flagella (×660).

Fig.14.—*Bacterium termo* (Ehr.) Duj., (granular form), two zooglœa states (×660).

Fig.15.—*Operculata elongata* Kellicott, (*b*) retracted (×330).

Fig.16.—*Cothurnia parallela* Maskell, (*b*) retracted (×660).

Fig.17.—*Chætonotus larus* var. *maximus* (encysted) (×330).

Fig.18.—*Pamphagus mutabilis* (×330).

Plate viii.

Fig.1.—*Macrothrix spinosa* King, female with winter egg, (*e*) only one pair of antennæ figured (×100).

Fig.2.—————— var. *dentata*, n.var., front edge of carapace (×660).

Fig.3.—*Trachelomonas volvocina* var. *pellucida*, n.var., (*b*) with short neck (×1000).

Fig.4.—————— *ovalis*, n.sp. (×660).

Fig.5.—*Lepocinclis Steinii* var. *suecica* Lemm. (×660).

Fig.6.—————— var. *australica*, n.var. (×660).

Fig.7.—*Menoidium pellucidum* var. *incurvum* (Fresenius) mihi, (*a*) from above (×1300).

Fig.8.—————————— var. *clavatum*, n.var. (×1000).
Fig.9.—*Difflugia Casinoënsis*, n.sp. (×660).
Fig.10.—————— *acuminata* var. *Levanderii* mihi (×250).
Fig.11.—————————— var. *bacillifera*, n.var. (×330).
Fig.12.—————— *Richmondiæ*, n.sp., (*a*) from above (×660).
Fig.13.—*Euglypha alveolata* var. *hamulifera*, n.var. (×1000); (*a*) overlap of plates, more enlarged.
Fig.14.—————————— var. *lævis* (Perty) mihi (×660).
Fig.15.—*Arcella papyracea*, n.sp. (×500).
Fig.16.—*Actinophrys sol* var. *simplex* (Schaudinn) mihi, but the rays show much fainter (×500).
Fig.17.—*Amœba verrucosa* var. *quadrilineata* (Carter) mihi (×500).
Fig.18.—————————— var. *limax* (? Dujardin) mihi (×660).
Fig.19.—————————— var. *maxima*, n.var. (×330).
Fig.20.————— *radiosa* var. *minutissima*, n.var. (×660).
Fig.21.—————————— var. *stellata*, n.var. (×220).